ASSESSMENT OF SITE SELECTION CRITERIA FOR OFFICE BUILDINGS IN SAUDI ARABIA

BY

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This thesis, written by **MAHMOUD HASSAN HAMWDA** under the direction of his Thesis Advisor and approved by his Thesis Committee, has been presented to and accepted by the Dean of Graduate Studies, in partial fulfillment of the requirements for the degree of **MASTER OF SCIENCE IN ARCHITECTURAL ENGINEERING.**

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DEDICATION

I dedicate this work to My Precious

FATHER;

MOTHER;

SISTERS;

BROTHER;

GRANDPARENTS

UNCLES AND AUNTS

Whose patience, continuous prayers and perseverance led

to this accomplishment

ACKNOWLEDGEMENT

I am most grateful to ALLAH, the almighty for providing me with time, health and ability to finish this research work.

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Finally, I have tried my best to avoid mistakes or inaccurate data and information in this study. I apologize for any mistake that was beyond my understanding and knowledge, and may ALLAH forgive me.

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THESIS ABSTRACT

Name	:	MAHMOUD HASSAN MOHAMED HAMWDA
Title	:	**Assessment of Site Selection Criteria for office Buildings in Saudi Arabia**
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Degree of Importance is presented to develop the factors for office building site selection in Saudi Arabia. It is used to determine the relative importance ranking of site selection factors for selection of a profitable site. Mainly, it was carried out through two sequential phases. In the first phase, 38 factors affecting the site selection process are identified through literature review, previous studies and interviews with the developers. Further, they are arranged in a hierarchy under relevant categories to set the rankings of the factors. In the second phase, a questionnaire survey was conducted and analysis was performed to determine the rankings separately for all the three types of respondents (Real Estate Developers, A/E and Commercial Brokers) and all together as well. The relative importance was evaluated on a scale of 1 – 4, 4 being very important. It was noticed in this evaluation that almost all of the factors range from somewhat important to very important but none of the factors was identified as not important. Hence, it shows that all of the 38 factors identified for site selection are valid and applicable.

A Weighted Evaluation method was developed to select an office building site out of 4 proposed alternative sites. This method is carried out in two parts: criteria scoring matrix and analysis matrix. Criteria scoring matrix is utilized to assess the correlated factors and to obtain their weightings through a questionnaire survey by performing pair-wise comparisons. A panel of comprising of 5 experienced experts of office building site selection was invited to participate in this survey. Further, eigenvalue method was used to check the consistency of data analysis. As a result of this analysis, weightings of all the factors were obtained. Analysis matrix was utilized to perform the case study of office building site selection. Scores were provided to all of the factors as per the conditions to each of the 4 proposed sites through extensive evaluation. Further, these scores were multiplied with corresponding weightings of the factors in the analysis matrix. The result of the analysis matrix demonstrates the ranks of all the proposed sites based on their final scores. Where site B attained the first rank followed by Site A.

بسم الله الرحمن الرحيم

خلاصة الرسالة

اسم الطالب بالكامل : محمود حسن محمد حموده

عنوان الرسالة : تقييم العوامل المؤثرة على اختيار موقع المباني المكتبية بالمملكة العربية السعودية.

التخصص : الهندسة المعمارية.

تاريخ الشهادة : صفر 1432 هـ

الهدف من هذه الرساله هو تقييم العوامل المؤثرة على اختيار موقع المباني المكتبية في المملكة العربية السعودية، حيث تم اولا تحديد هذه العوامل وعددها 38 عامل من خلال البحوث والدراسات السابقة في هذا المجال وكذلك المقابلات الشخصية مع مطوري العقار في المنطقة الشرقية بالمملكة. ومن ثم تصنيفها ضمن مجموعات حسب العلاقة بينها، ,ومن ثم تحديد درجة الاهمية لكل عامل منها ، وذلك من اجل تأكيد ان جميع العوامل صالحة للاستخدام خلال المرحلة التي تلي ذلك. وقد تم توزيع الاستبيان الخاص بذلك على كل من المكاتب الاستشارية المعمارية، شركات التطوير العقاري وسماسرة العقار. على ذلك حددت درجة الاهمية على مقياس 1-4 . نتيجة ذلك ان جميع العوامل المذكورة مهمة ولاتوجد اي عامل غير مهم. تم استخدام طريقة التقييم الموزون لاختيار احد اربعة خيارات لمواقع مقترحة لانشاء مبنى مكتبي. وقد استخدمت هذه الطريقة من خلال استبيان تم فيه انشاء مصفوفة للبيانات ثم تحليل هذه المصفوفة وتمت عملية التقييم من خلال العلاقة بين كل عامل والعوامل الاخرى. وتم الحصول على بيانات المصفوفة بواسطة عدد 5 من خبراء العقار المختصين في مجال المباني المكتبية. وبعد تحليل هذه النتائج تم تحديد وزن لكل من العوامل وعلى اثره تم استخدامه في عملية الاختيار للموقع المناسب. حيث تم تحديد درجة الاهمية للمواقع المذكورة لكل من العامل بواسطة احد المختصين في مجال اختيار المواقع. وحاصل مجموع نواتج ضرب هذه العوامل لكل موقع ينتج عنه التقييم النهائي لأفضل المواقع المقترحة لانشاء المشروع.

وللتأكد من صلاحية بيانات المصفوفة استخدم برنامج الماتلاب في اعداد برنامج لحساب ذلك وكانت النتيجة انها صالحة للاستخدام.

درجة الماجستير في العلوم
جامعة الملك فهد للبترول والمعادن
الظهران ، المملكة العربية السعودية
يناير 2011م

CHAPTER ONE

INTRODUCTION

1.1. Background

The idea of site selection has received wide interest throughout history (Mc Manus et al., 2005). Decision on selection of building location has increased awareness from both academic and business communities in the past two decades. This decision is taken by organizations seeking to locate, relocate or expand their operations through the identification, analysis, evaluation and selection between alternatives (Yang and Lee, 1997).

Nowadays, the site selection for a company is becoming essential. For some companies, this is done on a normal basis using proficient staff. For others, this may happen once in a life time, and the company may have no idea about how to begin and how to grow. It is abnormal for a company to waste time and money on the site selection process and then selects any site, sometimes the cheapest site is selected, and then the architectural engineering firm adjusts the design of the facility to the site (Molnar, 1983).

A comprehensive site selection process initiates by identifying the strategic goals of the company, the business requirements for the new process, and then tactical responsibilities. Some suitable areas for the project are identified and then evaluated to

find out the financial impact of the movement. Finally, a decision is made based on the evaluation results (Barovick and Steele, 2001). When looking for site, corporate real estate executives should be included in any site selection decision making process to understand the real estate solution, and to make sure that this solution accurately serves the business objectives (Barovick and Steele, 2001).

Office properties consists of those buildings which are classified under two classes; A and B. The A class includes uses such as professional services that one may generally find in town centers like firms of accountants and post offices. The B class consists of offices and light industry, although the second use may not affect the amenity of neighboring occupiers. Taking into consideration location for office uses, it is normally divided into the types of locations as being either on Business Park, usually out of town or edge of town, or in urban areas within a town or a city (Keeping and Shiers, 2004).

Developers have to plan very carefully before constructing new office buildings to provide proper site for tenants. Ensure that the location, design, local facilities, and ultimate cost meet requirements of the company. Consider all decision making stages to develop offices which can produce both economic and environmental benefits (Abel, 1994).

1.2. Statement of the Problem

Saudi Arabia is a rich developing country with enormous investment resources. It is developing very fast in every field including real estate. In recent times, real estate represents a major portion of organizations capital investment. So, investment decisions have a significant impact on the organization success and growth.

Now when relocations or consolidations are planned emotions run deeply. Corporate personnel usually have emotional, professional, family, or other attachments with communities, and these will affect decision of the choice of a particular site. These issues need to be recognized openly, but must be seen in the context of the objective process to select sites which also perform the business needs of the company. Sometimes also sites are identified before objective site selection criteria are developed.

The risk with this is that knowledge about identified sites may influence the criteria. For example, perhaps analysis of objective criteria shows that at least a number of square meters are needed to have enough space for preliminary requirements and future expansion. If the area of available site is less than that then the committee may try to make it work, although it clearly has significant shortcomings.

1.3. Significance of the Study

The importance of the study is come out of the following:

- In Saudi Arabia real estate represents a major portion of the organizations' capital investment but few researches have been conducted in this field.
- The real estate market in Saudi Arabia is witnessing a pattern of increasing demands driven by the growth in economy.
- Many companies in Saudi Arabia aim to expand their business at new locations.
- A similar study hasn't been done yet on the same topic in Saudi Arabia.
- Gathering all information regarding the site selection of office building in Saudi Arabia in one document will serve the owners as well as real estate developers.
- Also the selection of the proper site and facility can make valuable contribution to the profitability of the company.
- It is evident that a building site on which a business is established is a key factor for the success and growth of the business.
- An Assessment method of site selection factors is considered to be an important part of study for future improvement in real estate management and decision making for site selection.

1.4. Objectives of the Study

The main objectives of the study are as follows:

1. To identify the main factors that affects site selection of office buildings in Saudi Arabia.
2. To investigate the relative degree of importance of each factor.
3. To develop a method for office building site selection based on the identified set of factors.

1.5. Scope and Limitations

Although this research was done in the eastern province in Saudi Arabia, the results and conclusion can be applied to all office building sites in Saudi Arabia because of the similarities of the rules, regulations and business environment. The scope and limitations of this research is as follows:

1. The implementation of this work is limited to Saudi Arabia office buildings site selection.
2. The selection of the criteria is carried out through extensive literature review.
3. The selection of experts is based on their knowledge and experience in real estate field.
4. The respondents of the survey are Real Estate Developers, Commercial Brokers and A/E Consulting Offices in Eastern Province of Saudi Arabia.

5. The sample size is determined based on the population of A/E consulting offices, real estate developers and commercial brokers registered at the Chamber of Commerce in the Eastern Province of Saudi Arabia as of June 2009.

1.6. Research Methodology

The research plan set to achieve the objectives of the study consists of six main phases. These phases were illustrated in figure 1.1, and described as follows:

1.6.1. Phase One: Domain Analysis and Description

The literature review phase in this research implies:

- Reviewing the existing state-of-the-art literature in site selection to achieve a thorough understanding of the domain area. And reviewing some useful studies that are relevant to site selection for the purpose of examining a comprehensive list of factors that have most frequent use for site selection in Saudi Arabia.

- Conducting preliminary interviews with real estate developers and facility managers for the purpose of gaining an understanding of the local practice followed in site selection in Saudi Arabia.

1.6.2. Phase Two: Identification and Development of Site Selection Factors for Office Buildings in Saudi Arabia

This phase implies:

- Defining the influential factors that affect the process of site selection based on the research activities conducted in phase 1.

- Classifying the factors under a number of criteria where commonalities are shared.

1.6.3. Phase Three: Data Collection

This phase implies:

- Designing a questionnaire survey: After reviewing literature, the most influential factors affecting the selection of an office building site were determined and presented in the questionnaire as shown in Appendix-A. It was designed in such a way that it is simple and easy to understand by the respondents. The questionnaire survey was constructed in two parts as follows:

  General Information to give an idea about the surveyed organization and it includes:

  - Respondent Name

- The Organization Name
- Organization Type
- Job Title
- Experience
- Percentage of work in office building site selection projects compared to other types of projects

Technical Information is the main part contains a list of office buildings site selection factors to be ranked to determine the degree of importance of each one by the respondent opinion to give the relative importance of each factor.

The design of the questionnaire survey included open spaces for addition, changes or remarks by respondents. It was formulated using references as mentioned in the literature review [Chapter 2, 3].

This questionnaire survey aims at seeking the respondent perception about how these predetermined factors adversely affect and what is the level of importance for the process of site selection. These factors were then ranked in order based on the mean of each factor.

- Scoring the Questionnaire Survey: The first part of the questionnaire is about the organization itself, so no score was given on that part. In the second part, the

importance and affect of factors on office building site selection, a score was assessed and considered. The following options were given for each question:

- Very Important = 4
- Important = 3
- Somewhat Important = 2
- Not Important = 1

- Carrying out a pilot testing of the developed questionnaire survey: A pilot study was done through interviews with 5 respondents who have more than 10 years experience in eastern province of Saudi Arabia to ensure that all relevant factors are included, and also the wording, explanation and questions were clear and formatted properly and effectively. As a result of it the final questionnaire survey was developed. Special care went into phrasing the questions in a language that is easily understood by respondents. In anticipation that some respondents may be not fluent English readers or speakers, an Arabic version of the questionnaire was developed.

- Developing the sample size: A list of A/E consulting offices, real estate developers and commercial brokers was obtained from Chamber of Commerce in Eastern Province in Saudi Arabia. The size of the sample was determined based on statistical principles for this type of exploratory research by substituting into the formula as follows (Kish1995):

$$n_o = (p * q) / V^2 \cdots\cdots\cdots\cdots (Eq.1.1)$$

$$n = n_o / [1 + (n_o / N)] \cdots\cdots\cdots (Eq.1.2)$$

Where:

n_o: First estimate of sample size

p: The proportion of the characteristic being measured in the target population.

q: Complement of `p or 1-p

V: The maximum percentage of standard error allowed.

N: The population size.

n: The sample size.

For the purpose of getting the maximum sample size, the values of (p) and (q) were taken as 0.5 for both. The maximum standard error allowed in this study (V) was taken as 10%. The total populations (N) are 51, 59 and 42 from the list obtained from the Eastern Province Chamber of Commerce for A/E consulting offices, real estate developers and commercial brokers.

Substituting in Equations (1.1), and (1.2), to calculate the sample size:

- A/E Consulting Offices

$$n_o = (0.5 * 0.5) / 0.1^2 = 25$$

$$n = 25 \ / [1 + (25/51)] = 16.7$$

This means the minimum response rate for consulting architectural engineering offices population is (16.7/51)*100 = 32.7%, However the actual response rate was (21/51)*100 = 41.2% which exceeded the minimum requirements.

- Real Estate Developers

$$n_o = (0.5 * 0.5) / 0.1^{\,2} = 25$$

$$n = 25 \ /[1 + (25/59)] = 17.6$$

This means the minimum response rate for real estate developers population is (17.6/59)*100 = 29.8%. However, the actual response rate was (19/59)*100 = 32.2% which exceeded the minimum requirements.

- Commercial Brokers

$$n_o = (0.5 * 0.5) / 0.1^{\,2} = 25$$

$$n = 25 \ /[1 + (25/42)] = 15.6$$

This means the minimum response rate for real estate developers population is (15.6/42)*100 =37.1%, However the actual response rate was (18/42)*100 = 42.9% which exceeded the minimum requirements. The sample size is summarized in table 1.1.

Type of Organization	No. of Organizations*	No. of Responses required**	No. of Responses obtained
A/E Consulting Offices	51	17	21
Real Estate Developers	59	18	19
Commercial Brokers	42	16	18
Total		**51**	**58**

* Organizations registered in Eastern Province Chamber of Commerce as of June 2009
** According to the sample size formula (Kish, 1995).

Table 1.1: Sample Size

- Finally, the questionnaires were distributed to A/E consulting offices, commercial brokers and real estate developers of large organizations in Eastern Province of Saudi Arabia to get extensive ideas about the investigated factors based on their experience and knowledge in the field of real estate.

1.6.4. Phase Four: Data Analysis and Findings

This phase implies:-

- Analyzing data obtained from the responses of the questionnaire survey using statistical analysis system (SPSS). The mean index for each factor was calculated.
- Ranking the factors based on the calculated mean index.

1.6.5. Phase Five: Development of Methodology for Office Building Site Selection

This phase implies:

- A thorough investigation was carried out to identify numerous available methods of site selection and to utilize the most appropriate and effective method for office building site selection.

- Since, the rankings of the site selection factors obtained by the questionnaire survey is not suitable to be used for selection of the site (described in Phase 3 & 4), an alternative method which is weighted evaluation of criteria was used to determine the weightings of these factors.

- The criteria scoring matrix were performed by five experts of office building site selection. The experts were selected based on their experience and knowledge of the site selection factors. The pair-wise comparisons were formulated in the criteria scoring matrix. Then it was evaluated to obtain the weightings of the site selection factors.

- MATLAB program was written to facilitate the analysis process; since, it is not easy to manually determine the consistency. The concept or logic utilized in this program is power method applied to the eigenvalue method to perform the pair-wise comparisons.

- In the case study, the final part was to perform analysis matrix evaluations to select the most suitable site for the office building out of four proposed sites.

1.6.6. Phase Six: Conclusions and Recommendations

This phase implies:-

- Stating some useful conclusions based on the research observations and summarized results from phase 4 and5.

- Presenting some necessary recommendations that can improve the site selection process.

- Presenting some prospects for future research to be conducted in this area.

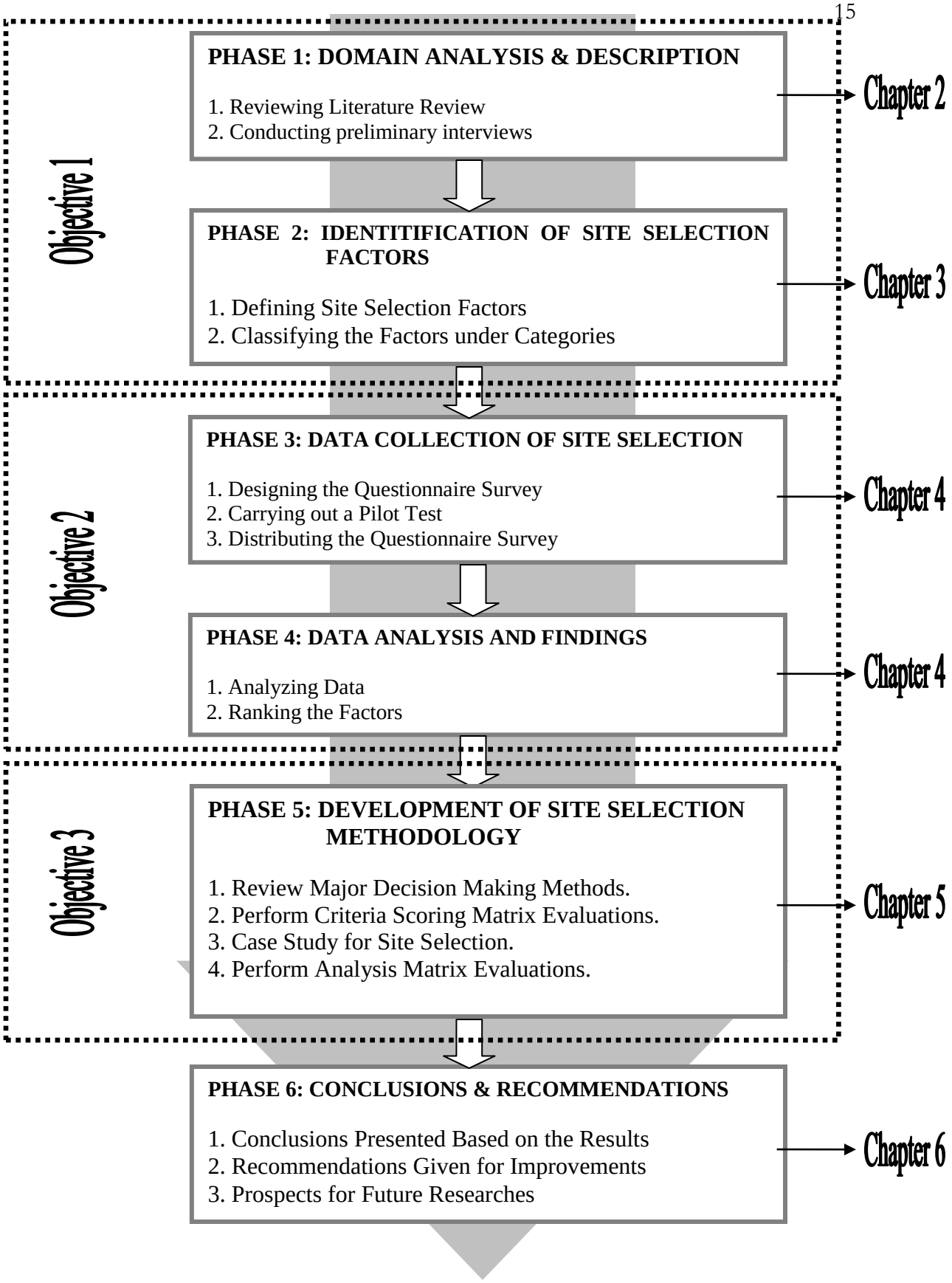

Figure 1.1: Research Methodology

1.7. Thesis Organization

This thesis is divided into six chapters as follows:

- **Chapter 1: Introduction:** This chapter is intended to give an overview of the problem, objectives, scope and limitations and significant of the study, the development of the questionnaire and sampling techniques use to measure the degree of importance, also includes the research methodology.

- **Chapter 2: Domain Analysis and Description:** This chapter is projected to give an extensive literature review of topics associated with the site selection process including previous studies.

- **Chapter 3: Office Buildings Site Selection Factors:** This chapter is the core part of the thesis, intended to give an overview of different site selection criteria and defining factors under each criterion.

- **Chapter 4: Data Collection and Data Analysis for Office Buildings in Saudi Arabia:** This chapter presents statistical methods used, tables and information deduced from statistical analysis, statistical results and interpretation of these tables. It also contains the ranking of factors based on the degree of importance.

- **Chapter 5: Development of methodology for office building site selection:** In this chapter a method to determine the weightings for the factors is established by using weighted evaluation technique based on the identified set of factors. The results of the case study and the selection of site is also incorporated.

- **Chapter 6: Conclusions and Recommendations:** This chapter provides the summary and conclusions of the research based on the objectives, and also some helpful recommendations, and ends up with prospects for future research.

1.8. Summary

This chapter has provided an introduction to this work including the statement of problem, significance of the study, objectives, and the scope and limitations. It also founded a proactive research methodology for this work and the thesis organization. The following chapter of domain analysis and description reviews the existing state-of-the-art literature of site selection process.

CHAPTER TWO

DOMAIN ANALYSIS AND DESCRIPTION

This chapter reviews the existing state-of-the-art literature in site selection to achieve a thorough understanding of the domain area. It also reviews some useful studies that are relevant to this research. Finally, it deals about conducting interviews with expertise for the purpose of gaining an understanding of the local practice followed in site selection in Saudi Arabia.

2.1. Office Buildings

Office buildings contain all kinds of managerial, professional, administrative employees in governmental and private organizations, and most of the businesses around the world. It could be owned by organizations or individuals. The physical requirements and services associated with office buildings can vary depending on the type of tenancies occupied. So for that reason office buildings in large cities are planned to become specialized by considering the type of occupancy. Investment risks of not renting the space are greater in office buildings, also the services expected by the tenant are usually expensive (Seldin and Swesnik, 1979).

The traditional city center office building lies in the scientific management theories of the late nineteenth and early twentieth centuries. Nowadays, office building plays a key

position in our economic and social frame. The growth of office buildings has then been illustrated by constant change as organizations have modified to new management systems.

Office buildings represent an important part of country's economic success, providing a significant tax base; an important source of foreign funds and one of the main investment areas for the financial organizations. In the future, it is expected that a larger amount of the working population will be employed in office buildings. Figure 2.1 helps to illustrate the growth in the financial and business services sector of some 1 million workers over ten years in UK. These statistics do not include the self employed (3.1 million in 1991) or other services (7 million in 1991) which include many office based activities in education, health care, research and development, recreation and personal services, as well as 1.6 million employed in public organizations.

Office buildings also play an important role in the cultural and social front. They contribute to the aesthetic value of cities and the economic feasibility of associated activities including retailing and support services. Without office buildings, the lives of many would be unproductive (Markland, 1995).

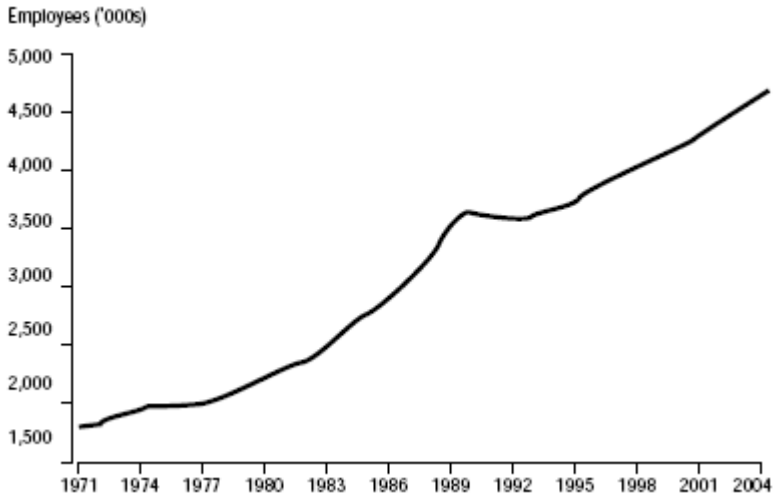

Figure 2.1: Employment growth trends in the financial and business services sector in UK (Cambrige Econometrics, 1994)

2.2. Location and Site

The choice of location and site depends on evaluation of demand, size, and input requirements. Though usually referred as identical, the terms ‘location’, and ‘site’ should be distinguished. Location refers to a wide area like city, an industrial zone, or a coastal area; whereas site refers to a specific piece of land where the office building would be constructed. Site is influenced by a variety of considerations: proximity to raw materials, market changes, availability of infrastructure, labor situation, governmental policies and other factors.

2.3. Location Selection

Selecting a location for a company is a difficult job. Often, the confusion exists that by selecting a number of data on available location options, one can identify the location that best meets the purpose. However, in assessment of location risks and impact on the overall company performance, data from the history will not be enough.

When Companies look for an approach to select the best site in an efficient way, it is preferable to perform such evaluations only for a small number of sites (Spee and Douw, 2003). So the location decision maker shall have a clear picture about the proposed location alternatives (Browning, 1980).

2.4. Risks Associated with a Site Development Scheme

Developers are often busy in balancing between risk and return. Risks occur at the beginning of the real estate development process. At this stage, major strategic decisions are made about the development plan and there are still many doubts. Returns, on the other hand, occur at the end of development process in the form of profit.

Part of evaluating the development risk has to be considered when locating a suitable site. It is not just finding a piece of land because it involves knowledge of geographical, town

planning, consultation, environmental, engineering, social, political, and economical issues (Keeping and Shiers, 2004).

2.4.1. Risks in Renting Space

The demand of office space varies extensively over time. Office space demand is related to the needs of the business and professional community. Different locations have different rents for the same space with similar services. So the owner of an office building that is out of the appropriate location has some serious economic problems. Unlike a high rise apartment building, the repairing, remodeling or improvement may still not pay-back as expected. Lowering the rents in an unattractive location usually may not solve owner problems in profits.

The risk in unleased or short term leased office building is greater than the risk in high rise apartment. Originally attracting tenants is related to the status of the location and to the personal and specific business needs of the tenant. So locations with well planned buildings attract the best economic tenancy. Office buildings can run for up to 20 years, however if tenant move into a building with five years leases, and the building does not provide adequate services or have a poor design the tenant will leave early (Seldin and Swesnik, 1979).

2.4.2. Risk in Location

The increase in usage of the suburban areas has increased the number and size of non downtown office buildings. Although riskier, sometimes the profit can vary. Therefore poorly located office spaces will often not carry enough rents to cover operation costs. A reduction in the rent will also not be useful in leasing a poorly located office building as it can represent great risk in selecting a location (Seldin and Swesnik, 1979).

2.4.3. Risk in Tenancy in New Buildings

In the development of new office building, financing is not readily available, unless major portion of the building is leased in advance. The effect of the income from the office building owner is joined to the length of the lease and financial consistency of the tenant. Cost of developing a new office building that is not leased prior to construction can be only estimated after the basic structure is completed. Since, interior layout takes about 30% of the total cost of the building, the tenant must be known to take all the interior requirements under consideration (Seldin and Swesnik, 1979).

2.5. Importance of Site Selection

There are a number of trends that mainly changed the business site selection on process. Some of these trends have increased the complexity of site selection process and

compressed its nature. Others have made it more difficult to provide acceptable level of decision by increasing its importance. With respect to the first type, the extension of two major trends consolidation and globalization has made the process more complex. The complexity has been enlarged by the appearance of the e- business revolution, a trend that has even more dramatic implication on the site selection process (Rabianski et al., 2001).

2.5.1. Consolidation

The direction to consolidation has changed across many industries including real estate service provider and building users. In terms of the demand, for many companies consolidation created necessary real estate excesses and or differences. Real estate departments in fast integrated industries must make decisions under excessive pressure (Rabianski et al., 2001).

2.5.2. Globalization

A second direction that is a somewhat related to consolidation, globalization, has made the site selection decision more difficult and important to organizations. In case of increasing number of companies directly operating in the worldwide, the site selection process takes on increased complexity. For these companies, the site and other real estate needs must be managed carefully with a wider scope. Also real estate department must

learn how to deal with new regulations that affect ownership, development and leasing of business facilities (Rabianski et al., 2001).

2.5.3. E- Business

The site selection process has become more complicated with the development of e-business. It will have a significant impact on location preferences of a large business. It has also applied pressure on the length of time a company can plan a capital situation, resource requirements and real estate needs. However, e- business is shifting away from strict workplace solution to ones that are more flexible in terms of the quantity and quality of real estate (Rabianski et al., 2001).

2.6. Reasons for Site Search

Facilities managers should be aware of internal and external demands that require a site search. Generally the need for the site search is determined by the internal demands of a company. This demand can result from positive or negative factors influencing the company. Some of the positive factors would be growth of the company outside the physical boundaries of its present location, join with another company requiring more or new space, a change in markets, or beneficial taxes in an isolated location and government incentives can be a considerable reason for finding a new business site. On the other hand, there are external demand for a site search such as property demolition

and loss of labor force. Whether the demand is internal or external the approach to site search and analysis should be internal (Hubbard, 1997).

There are a number of reasons for a site search such as:

- The current site is insufficient for the company.
- The company is growing into a new market area.
- Operations are being decentralized.
- The company is relocating to area closest to an existing or new source of raw materials.
- Operations are being consolidated at a new location.
- The company is relocating to area where specialized and skilled labors are available. (Molnar, 1983).

Also there are some general reasons why companies decide to relocate or expand. Usually, they can be divided into product market like growth of existing products or services, development of new local market, expanding sales area, demographic shifts, and a product life cycle. Non product market reasons include vertical or horizontal integration of the firm, critical local business climate, decisions forced by the main company, obsolescence of existing facilities, enhancing the firm, retention problems with professionals, and improving the quality of life for corporate executives (Pittman, 2006)

2.7. Site Use Alternatives

The nature of site selection process depends on the end use of the site. There are several alternatives for organization to use the site if reasonable locations are unavailable. The alternatives to be considered varies from rent of a space in an existing building, purchase a land with a view to major construction for long range company development, rent in an industrial or commercial region where the developer will construct the building according to company specifications, buy land with the building to be constructed by a local design firm to corporate specification or buy land on which building will be designed by architectural engineering firm and then constructed to the company specifications (Molnar, 1983).

2.8. Site Assessment Phases

2.8.1. Site Selection

Land development is usually required due to: clients have a site and choose a program to develop the site, or choose a site to satisfy the intended need. Across the urban and country areas parcels of land varies in size, shape, character and context. Site selection involves identifying and evaluating alternative sites and selecting the best location for the intended program (See figure 2.2).

Company site selection generally follows a consistent way as there is no single way to approach site selection. It represents a series of separate but highly organized analyses

and decisions. The typical steps involved in finding a location of a new or expanded office facility can be adapted from the real property development literature (Rabianski et al., 2001).

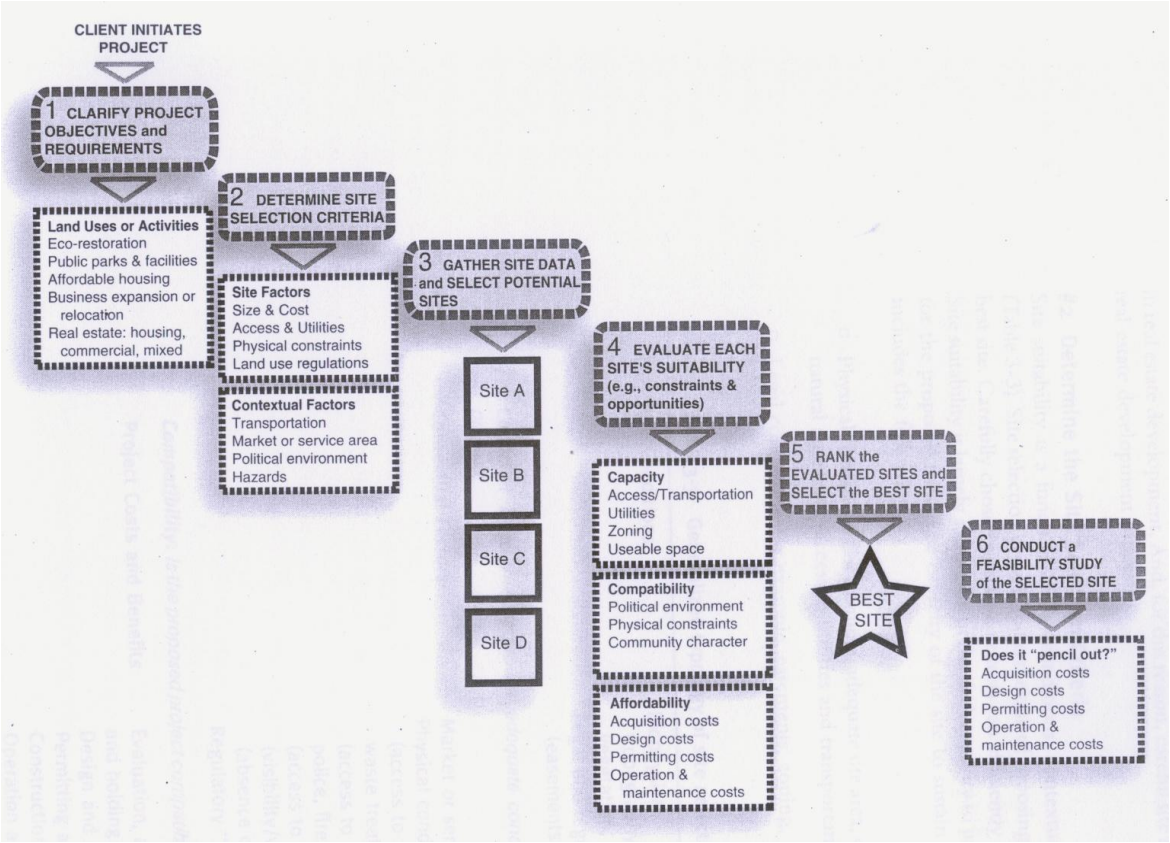

Figure 2.2: Site Selection Process diagram (LaGro and James).

New site selection decisions are best made when business needs and opportunities, vision and goals to be achieved are clear. The site selection team processes the right skill set and work to a plan. Figure 2.3 illustrate site selection process.

Figure 2.3: Site Selection Process (Bergeron, 2005).

A comprehensive site selection process works with the strategic goals of the company by identifying appropriate areas, evaluating those areas and determining the financial impact of the move, and then the implementation of any resulting action (Barovick and Steele, 2001).

2.8.1.1. Define the Current State and the Business Need

Site selection needs to be understood within its proper context. Most site selection is undertaken as the result of a strategic, cost reduction, or relocation action. The decision makers need to clarify the key business objectives; assess the business drivers for the operation; determine the location impacts on the success of the operation; establish any configuration options, if available; and evaluate the strategic benefits and risks which might be associated with the location strategy (Barovick and Steele, 2001).

2.8.1.2. Identify and Evaluate Qualified Locations

The decision makers should be able to identify locations that will serve the need. The main challenges in this stage include finding appropriate measurable dynamics for each major business driver; developing a method for the relative importance and developing a process for gaining acceptance of the results (Barovick and Steele, 2001).

2.8.1.3. Field Verification, Negotiations and Implementation

During this stage, initial steps may be made towards identifying, negotiating, from local or regional governments. Also, verifying the availability of suitable land for development. Once final decisions of site are made, implementation planning can proceed (Barovick and Steele, 2001).

IBM-PLI has developed a location selection approach (See figure 2.4) which takes companies efficiently through strong process of selecting a shortlist of locations and then concentrates on the few remaining candidate locations in the required level of details (Spee and Douw, 2003).

Figure 2.4: Typical approach of site selection for IBM - PLI (Spee and Douw, 2003).

2.8.2. Site Inventory

The site inventory is an essential step in understanding the character of the site and the physical, biological, and social or cultural relation between the site and the surrounded landscape (See figure 2.5). The features of the site and its surroundings determine the attribute data collected for the site inventory. If data gathering is not well focused, site consume great amount of time and money (LaGro and James).

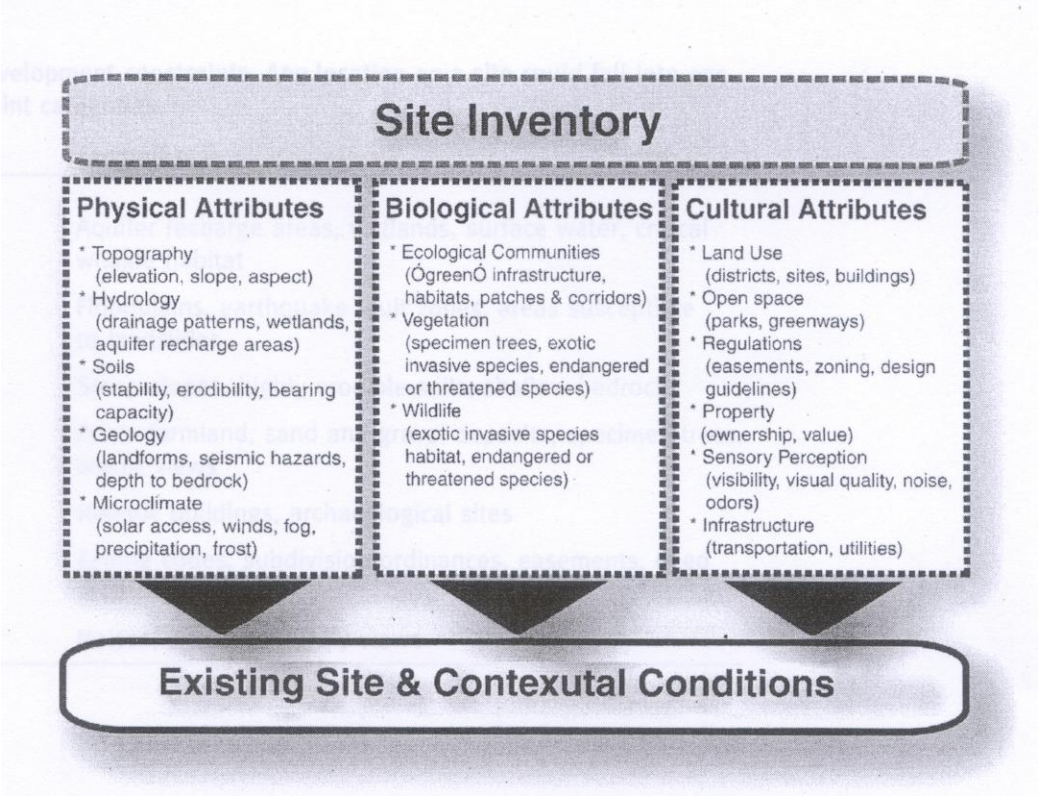

Figure 2.5: Site inventory (LaGro and James).

2.8.3. Site Analysis

Site analysis shows the site's suitability for the proposed uses. This suitability is a combination of the site's assets and liabilities or opportunities and constraints. The site's inventory can be combined to determine the site suitability for development (See figure 2.6). Defining the site opportunities and constraints is essential for land planning and design.

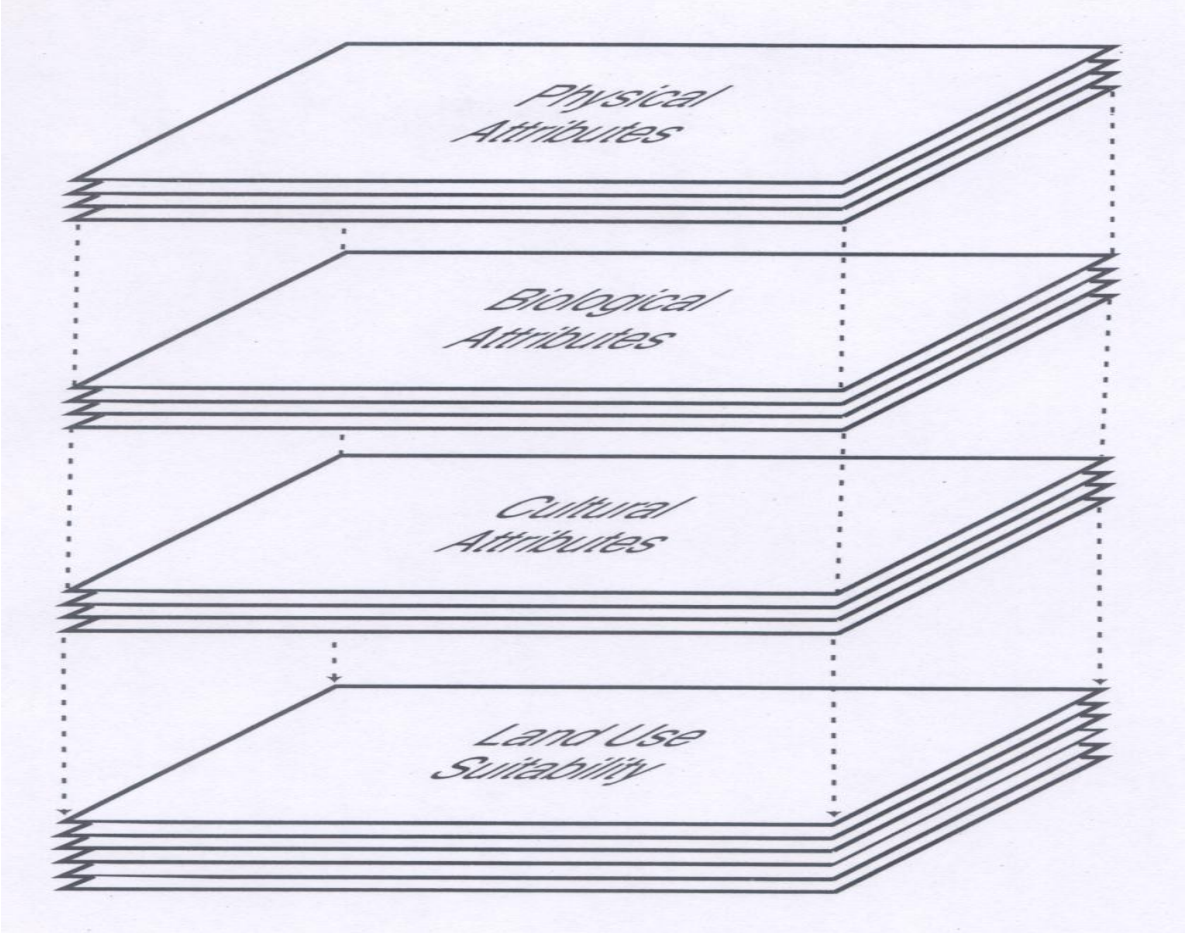

Figure 2.6: Relationship between attribute mapping and land use suitability analysis (LaGro and James).

2.8.4. Site Evaluation Committee

Once the Site Selection Process has been initiated, the first step is to establish a Site Evaluation Committee to recommend a preferred site. A successful site evaluation effort should include the input of a number of professionals with a variety of expertise (See figure 2.7). The team should be selected on the basis of the particular needs of a given project (University of Illinois, 2003).

The Site Selection Committee should have adequate information and background to understand the building requirements during the facility planning and programming phase. In this phase, discussions that will determine many of the site's requirements should be conducted (NAATAP, 2008)

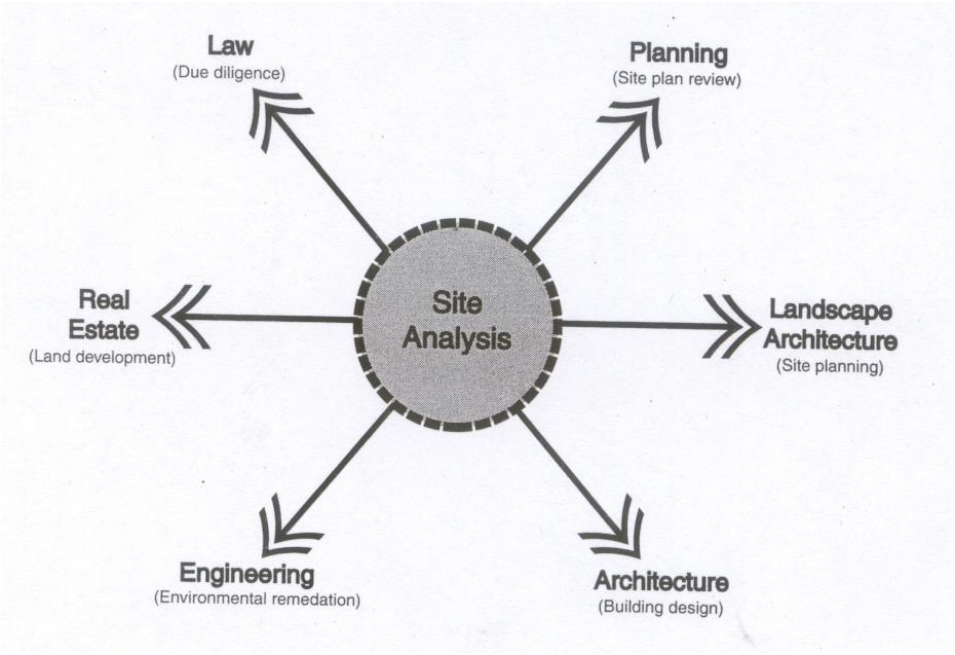

Figure 2.7: Utilization of site analysis information (LaGro and James).

2.9. Previous Studies

To provide background and some historical context on this subject, a brief review of the previous studies is provided.

Study by Goldstein (1980), indicated that the factors that are most important to site selection decisions were geographical location, high worker productivity, land transportation and a low union profile. Less importance was a stable state government,

skilled labors availability, long term financing, and energy source. All other factors were slightly less important.

A survey by Roth (1983) of companies in 35 cities showed that the issues of prime importance when making decisions regarding corporate relocations were: firstly, convenience of an operational location; secondly, economic advantage of a location; and thirdly quality of life. Other important factors included obsolescence of existing premises; shifts in the availability of needed support services; and changing demographic patterns.

In Bowlby (1988), a comprehensive study of corporate relocation decisions asked managers to evaluate 20 important criteria. It was found that market size, labors pool, market potential has high importance. Factors that are not highly rated as being very important included cost accessibility, infrastructure, market proximity and transportation. Factors that the study found less important to location decisions included taxes, tourism, competition, quality of life, utility services and government support.

According to Tiller (1994), corporate real estate managers, economic development officials and site selection consultants agree that although transportation access, utilities, the availability of services, and quality of life all play a role in corporate site selection decisions, the financial bottom line is still the most important factor.

A study by Gooley (1998) found that four factors are still of primary importance in site selection. The first is physical infrastructure including natural and man-made features. Second is proximity to suppliers and customers. Third are political and tax considerations including government incentives and political climate. Fourth, for companies to which they apply, are international trade considerations.

A study by Group in the early 1990s, found that although incentives are important in encouraging a company to move to a particular location, they are important only once an area is on the company's short list of possible locations. The study revealed that incentives ranked fourteenth out of a total of 17 location decision-making factors. 11 Promises of infrastructure improvements, property tax abatement, tax credits, subsidized training and other incentives do not play a major role for companies in the early stages of site selection.

A joint study by Ernst & Young's Real Estate Advisory Services and the National Real Estate Index asked respondents to rate site selection factors in six categories: real estate-related costs; accessibility; taxes and regulatory environment; quality of life; labor quality and availability; and infrastructure. The study found real estate related costs to be the most important site selection category. The most important site selection factor, low lease rates, was within that category. The fourth most important factor, low construction costs, also falls into the real estate related costs category. The second highest ranked individual factor, an educated workforce was within the category of labor quality and availability. Major highways, a factor in the infrastructure category, ranked third. Site-selection

factors in the taxes and regulatory environment and quality of life categories ranked fairly low.

Robertson and Reichert (2000) asked the respondents to indicate the three most important factors in making their final site selection decision. As indicated in table 2.1, 19 out of 34 respondents rated site location as one of the top factors, with 6 respondents ranking location as the most important factor. Site size and configuration received 13 top three ratings, with 4 firms indicating this as the single most important factor. 11 respondents rated their preference for either a new or an existing building as one of the top factors, while 9 indicated that this was the single most important factor. Transportation cost of renovation or construction and availability of a skilled workforce received between 8 and 9 top three ratings.

Frequency of top three Ranks		**Rated 1st**	**Rated 2nd**	**Rated 3rd**	**Total**
Factors					
1.	Site Location	6	8	5	19
2.	Site and Size Configuration	4	4	5	13
3.	Transportation	2	3	4	9
4.	Taxes	0	0	0	0
5.	Cost of Renovation and / or Construction	1	3	5	9
6.	Skilled Labor Forces	3	1	4	8
7.	Utilities	0	1	1	2
8.	Crime and Safety	1	2	0	3
9.	Environmental Liability	0	0	0	0
10.	Preference of new or existing building	9	1	1	11
11.	Other	2	1	1	4

Table 2.1: Robertson and Reichert factors ranking (Robertson and Reichert, 2000)

The data recommend that three broad factors influence relocation decisions: physical structure and cost; amenities; and location. Among the three, physical structure and cost is the dominant factor. The survey indicates that while environmental liability has a high priority in the early screening process, it does not appear to be an important factor in the final site selection decision.

(John Abel, 1994) 212 major companies have relocated from central London to other parts of the UK. Isolating explanations for a major corporate relocation has always been a difficult task. Recent research from Capital & Counties, one of the top ten property companies in the UK, showed that, while cost is an important factor, the five key criteria in the choice of premises were:

(1) Proximity to major road networks

(2) A modern prestigious building

(3) Good car parking

(4) Flexible space at the right price

(5) Secure working environment.

Capital and Counties' research highlighted that other factors influencing a relocation decision included the desire for banking facilities close by, a wide range of shops within walking distance and office space which can be adapted to the occupier's specification. All companies also mentioned the importance of the developer working closely with occupiers at all stages. The research undertaken did not highlight environment as priority, although it believes that in future years it will become more important (Abel, 1994).

To help summarize the literature, table 2.2 indicates which broad categories of factors were considered in some of the studies mentioned above.

2.10. Interviews with the Developers

In addition to the review of these previous studies, interviews were conducted for the purpose of gaining an understanding of the local practice followed in site selection in Saudi Arabia and verifying the applicability and validity of the collected factors from this research. The interviews with 5 developers have immensely affected in understanding the local scenario and collecting new factors which are not found in the literature review. The result of these interviews can be seen in table 2.2.

Factors		**References (Authors)**									
		Paul De Francis (1999)	Crittenden & Morgan (1997)	De Chiara & Koppelman (1984)	Ernest & young (1998)	Sheridan (1994)	Deloitte & Touche (1990)	Gooley (1998)	Goldstein (1980)	Roth (1983)	Robertson & Riechert (2000)	Interviews with 5 Developers
1.	Width of main street			✓	✓							
2.	Allowable building height			✓								
3.	Accommodation for parking spaces	✓	✓	✓							✓	
4.	Existing site development	✓	✓	✓				✓			✓	
5.	Proximity to future expansion of community	✓	✓	✓							✓	
6.	Suitability of the proposed use		✓	✓			✓	✓	✓	✓	✓	
7.	Distance from services	✓	✓	✓							✓	

8.	Location within the city fabrics	✓		✓			✓	✓	✓		✓	
9.	Security and safety zoning										✓	✓
10.	Quality of life				✓	✓				✓		
11.	Landscaping	✓	✓	✓								
12.	Aesthetic value		✓	✓								
13.	Site area		✓	✓							✓	
14.	Allows for expansion	✓		✓							✓	
15.	Site geometry			✓							✓	✓
16.	Topography	✓		✓							✓	
17.	Availability of electrical power	✓	✓	✓	✓	✓					✓	
18.	Availability of water utilities	✓	✓	✓	✓	✓					✓	
19.	Availability of sewage utilities	✓	✓	✓	✓	✓					✓	
20.	Availability of site drainage	✓	✓	✓	✓	✓					✓	
21.	Availability of telephone lines and IT services	✓		✓	✓	✓					✓	
22.	Alternative energy source		✓						✓			
23.	Quality of air			✓							✓	
24.	Orientation		✓									✓
25.	Soil condition	✓	✓	✓								
26.	Hydrology											✓
27.	Proximity to natural hazards	✓	✓									
28.	Potential for hazardous materials	✓	✓								✓	
29.	Climate		✓									✓
30.	Tolerance for Background noise		✓	✓								
31.	Availability of public transport		✓	✓		✓	✓	✓	✓		✓	
32.	Ease of transporting construction materials		✓	✓							✓	
33.	Accessibility	✓	✓	✓	✓						✓	
34.	Land acquisition and cost	✓	✓	✓	✓		✓			✓	✓	
35.	Market changes			✓								✓
36.	Taxes			✓	✓	✓	✓	✓			✓	
37.	Development cost	✓	✓	✓								
38.	Labor availability and cost				✓	✓	✓		✓	✓	✓	

Table 2.2: literature review summary

2.11. Summary

This chapter includes state-of-the-art literature review for the site selection. Data was collected from previous studies on this field. The following chapter discusses the main criteria of site selection and factors under each criterion.

CHAPTER THREE

OFFICE BUILDINGS SITE SELECTION FACTORS

This chapter investigated the influential factors that affect the process of site selection for office buildings in Saudi Arabia based on the research activities and interviews mentioned in the previous chapter, and classified them under criteria where commonalities are shared (See figure 3.4).

3.1. Site Selection Criteria and Factors

Quantitative and qualitative factors related to specific business must be evaluated to get the overall objectives (Tresslar, 2006). Decision makers have to consider many factors for selection of suitable location (Witlox and Timmermans, 2000). In the following part seven major categories for office building site selection are mentioned and under each criterion a group of corresponding factors are represented:

3.1.1. Zoning Regulations

Zoning is a set of land rights and forces applied on the land owner. Zones are classified into commercial, residential, manufacturing and agricultural (Kemper, 1979). Zoning regulations include a set of governmental controls placed upon land use in specific

location in order to get the maximum benefits of health, ethics, safety and general benefits of the community (Shim et al., 1996).

Architects and Planners receive vacant zoning to establish certain physical constraints on any project from the beginning. Usually the developer is looking for sites in zones that have the highest and the best profit. When a site is zoned it's important to receive approval from local authorities to change it to another type of land use (Barrett and Blair, 1982). For getting approval of that, many problems occur and a lot of time and money is consumed. The use of the site for office buildings must be compatible with existing and expected zoning, and land use. (Mearig et al., 1997).

City planners and zoning commissions should be consulted when studying zoning constraints. In some smaller areas the city engineer can do that (Barrett and Blair, 1982). The following factors are considered for zoning regulations:

3.1.1.1. Width of Main Street

Width of Main Street is one of the main factors that affect site selection for office building. Mainly, design capacity of the street have to support land uses. Width of street usually affects the decision of the best way to bring vehicles onto the site. The planner should be careful about access egress to and from main streets, using of small street for safety, slow access and egress and position of entrance as far from street intersections as possible. They may use allay ways for distribution edges if it is possible. To avoid

crowded on-site pavement of distribution roads, the vehicular entrance usually used to regulate the general location of parking.

3.1.1.2. Allowable Building Height

The overall massing of the building is affected by building height limitations and other considerations resulting from codes and local regulations (White, 1983). In urban design the problems of height and setback are strongly organized. Building heights and setbacks create the nature of the sky line in all regions of a city. So, the main effect of height limitations may be aesthetic.

Height may regulated by specifying maximum number of meters, maximum number of stories depending on width of the street on the fronts of the building. Height also is made depending on the distance back from the lot line in the form of setbacks. Those kinds of regulations results in the wedding cake shapes characteristic of building in central area of cities. For urban design reason, some cities have attempted to establish minimum and maximum height limits. Some special cases of height limitations are those required around airports at the end of runways (Patterson, 1988).

3.1.1.3. Accommodation for Parking Spaces

One of the difficult problems that meet planners is parking spaces. However, the user has different approaches toward parking. Everyone occupied in the rental or leasing space

will be agreed about the concern of parking (Brooks, 1988). Parking requirements become an important issue of site selection analysis and the site planning process for many projects in urban and suburban areas (AIA, 2001). Parking spaces may also cause a major problem to a new development in an urban area. A combination of open space and parking requirements may affect the new type of development that can take place. Parking requirements only may cause an economic failure or lead to change the original type and concept of the project (Barrett and Blair, 1982). Availability of parking spaces for employees and visitors is important.

Most of zoning laws specify the number of parking required per unit of floor area. Typical parking requirements for office buildings are one stop per 30 - 50 net square meters of floor area. An office employee may occupy an average of 20 square meters of floor space. There is no office building design provide as much parking space as one space per occupant, so the amount of space needed for parking is always a key concern.

The amount of parking space needed per car can be reduced with double or triple parking. This solution will be cheaper than the construction and maintenance cost of 350 square feet per car. Mechanical parking systems are used to reduce space, but they usually need flexibility to the requirements of users and are not very successful (Kemper, 1979).

3.1.1.4. Existing Site Development

The types of land uses that may be analyzed are recreation, residential, commercial, and industrial use. Knowledge of existing land use on and/or adjacent to the site provides the planner with an understanding of constraints and opportunities. It is often represents significant costs and must be weighted for that reason. Also it is important to document elements that are not considered for land uses but are related to certain land uses like road, fences, and utilities. Undeveloped land is preferred and if developed or currently used, alternative sites must be available for existing uses (De Chiara and Koppelman, 1984).

The physical ability of a property depends on its on-site characteristics and improvements. Generally, these improvements determine how property will be used and how to influence its productivity. For example, an office building is constructed on a site, which prevents to use it as another type of building. A new use of the site is feasible only if it is so profitable that it can absorb the cost of change of the existing improvements for its needs (Ring and Dasso, 1977).

3.1.1.5. Proximity to Future Expansion of Community

This factor evaluates long term planning of land use related to office buildings sites. A subjective evaluation of how well the site corresponds to future expansion and land use in the community (Mearig et al., 1997).

Site selection decisions are determined by set of data combined for large geographic areas, such as states and provinces and municipalities. When suitable communities have been identified, additional data are collected on potential sites within each area. This selection process may cover a range of spatial scales, including the analysis of the site as well as the communities where the site is located. Businesses that are growing or relocating may evaluate sites in several areas (LaGro and James, 2008).

3.1.1.6. Suitability for the Proposed Use

The suitability of a specific site for the proposed facility depends mainly on the location factors that are selected, evaluated and analyzed, which impact the company objectives (Yang and Lee, 1997). Feasible office building site is either selected or rejected based on each site's suitability for the proposed use (LaGro and James, 2008).

The objective of site analysis during the site selection process is to identify the best site based on the physical and cultural characteristics of the site and its surroundings, as well as the site adaptability with the expected use (AIA, 2001). Social or economic analysis is also important to decide where the site could be selected. If all possibilities are open suitability is usually the main consideration in the evaluation of site alternatives (Ring and Dasso, 1977).

It should be known that purpose of the best suitability of particular site does not mean that the site should be developed for a given function. Suitability studies depend on the degree to which a site is suitable for a given function. Results related to the real site

selection can be made only after all related issues have been evaluated (De Chiara and Koppelman, 1984). So the selection of a good location is important whether for purchasing real estate for investment, business use, or personal use (Barrett and Blair, 1982).

3.1.2. Geographical Aspects

Geographical analysis is made to determine the geological conditions that affect the design, safety, effectiveness, and cost of a proposed project. The investigations are performed to determine the general geographic setting of the project that influences the selection of a site (De Chiara and Koppelman, 1984). This criterion consists of the following factors:

3.1.2.1. Distance from Services

In some cases, a developer or owner can identify an existing facility for food service, bank, health care center, mosque, etc. which is shared between several offices and where close proximity is important. If more than one facility is important, this factor may have to be scored several times. In most cases the adjacency is important because it decreases the cost of employees and customers transport. So the requirements of the new development may exceed the existing capacity of community services, then the developer should prepare alternative development concepts to illustrate the benefits to the community.

It may be helpful to use certain national standard and local ratios of policemen and firemen per area to determine impact of the project. If the expected population of the project does not agree with ratios, then some modifications can be made for the development of the grounds (Barrett and Blair, 1982).

3.1.2.2. Location within the City Fabrics

Location of a site within a city presents the relation between the site and its surrounding. It may get higher degree of importance in terms of priority listing because it reflects the status of the area that it belongs to (CMD, 1996). Location has two meanings; one is the relation in terms of movement of people or goods from the property to and from other properties. The second meaning involves the area around the property in an aesthetic value (Ring and Dasso, 1977).

Location analysis is very important element for site selection process. Sixty percent of the firms within the International Development Council includes the location analysis among their offered services (LaGro and James, 2008).

3.1.2.3. Security and Safety Zoning

The location considerations of the site have a reflective effect on protective measures that may be required. The three main items that may have effect on protection requirements are physical, social, and political influences. Analysis on area may specify many

problems involving these factors, but this does not necessarily mean that plan to occupy the site should be neglected. If the problems are recognized in advance to the site development plans, protective plans can be created to identify and mitigate risks (Hopf, 1979).

Security consists of a list of measures taken by a company to provide the protection of the property, personnel, material, and facilities against illegal entry or any other criminal work (Cherry, 1986). Successful security programs at a maximum security building are always based on a general site planning (Gigliotti and Jasson, 1984). The layout of buildings on site has a significant influence on an organization cost of security. So, a good zone today has to be a high secure zone (Hopf, 1979).

3.1.2.4. Quality of Life

Quality of life consists of many economic, demographic and environmental factors that people identify as getting good things in their community (Rabianski, 2007). Also it includes housing and other costs of living, outdoor spaces, cultural attraction, traffic time, schools and other objective factors (Gail, 1993).

Quality of life studies are evaluated by an individual, family and society. The community view in a QOL study focuses on the characteristics of the community on the location, not on the individual point of view of those attributes. These studies include the following attributes:

- Demographic features like the population size, educational success and density of distribution.
- Economic information like employment or unemployment rates, salaries, taxes, price of housing and cost of living.
- Society information like crimes and poverty levels.
- Public services like type and quality of police and fire protection, educational services, health services, transportation services and business climate.
- Environmental information like air and water quality and traffic jams.

3.1.2.5. Landscaping

Landscape depends on a random selection of individuals for assessment. Landscaping quality plays an important role in site planning decision making. There are two approaches used when assessing landscape visual quality. The objective approach that assumes visual quality is natural landscape quality; depends on experts in landscape aesthetics for assessment. This type of evaluation takes into account an area's attractive qualities like proportions, line, color, and texture. While subjective approach assumes that visual quality is simply evaluated by the eyes of the user. This approach ignores evaluations by qualified experts in design or aesthetic (LaGro and James, 2008).

Proper landscaping is usually used to cover unattractive elements of the site and increase its natural beauty. Landscape planting is mainly aimed to enhance the exteriors, reduce

local noise and dust, integrate the building with the adjacent open area and provide right scale and character to the building (Molnar, 1983).

3.1.2.6. Aesthetic Value

The visual quality of the site itself as well as visible off-site features can be basically important to the success of the project. The distance around the site that is related to the use of the site in the future varies with what can be seen from the site. Views to important historical buildings, famous mountains, or other land marks are important site attributes because they represent a clear sense of place. Vertical elements such as buildings and trees have considerable influence on visual quality.

Land use on adjacent site can influence on office building site in different ways. It may benefit from a good visibility to the site from adjacent street, highway and other off-site locations. Visibility is a form of advertising usually increases purchasing prices or rental incomes (LaGro and James, 2008). The basic land form of a site is a visual and aesthetic resource that influences the function.

Aesthetic resources are basically concerned about locating sites for recreation about nature. These resources depend on land form, plants pattern, views, panorama and image of the site (De Chiara and Koppelman, 1984). Sites that are planned for future development must be analyzed to determine significant aesthetic value. Natural features and spatial elements are all important for the design process. The character of many sites is distinguished by the arrangement of these elements (Rubenstein, 1969).

3.1.3. Spatial Configuration

Spatial configuration concerns with different aspects of a site measurements. The following factors are considered:

3.1.3.1. Site Area

Land development and redevelopment takes place over different site scales. For example, many single use commercial projects require small sites of less than 4000 square meters. In contrast, large scale residential and mixed use development may require sites of 40500 square meters. Sometimes two or more adjacent parcels of land are combined to produce one larger parcel under a single ownership. Development potential is affected by the land size. If all other factors are equal, larger site can house wide and different developments than smaller site.

On smaller sites, external factors directly impact the potential uses of the site. Larger sites may allow better flexibility in accessing the site and in accepting requirements on the site (LaGro and James, 2008). The site should be large enough to accommodate the proposed building and consideration should also be given to good land coverage (University of Illinois, 2003). Site size in relation to the functional requirements indicate whether we are working with a fixed or loose building to site situations. Site border dimensions must be measured directly to verify (White, 1983).

The level of improvement of provided services and their permanence, affects the quantity of services to be delivered from a site. The size of the improvements also affects the quantity of services to be given. For example, 186 square meters building does not compare with 18600 square meters building in satisfying the needs of an office building (Ring, Dasso, 1977).

3.1.3.2. Allows for Expansion

The site allowance for future expansion is preferred by many companies. Consideration should be given to the possibility of future expansion of the facility whether or not it is identified in the planning phase (University of Illinois, 2003). Additional site area also allow for the integration of open spaces in some projects. Some natural areas and buffer zones use to separate unsuited land uses and undesirable screen views off-site (LaGro and James, 2008).

3.1.3.3. Site Geometry

Site shape is import to its productivity mainly in urban areas. Sites that are small or irregular shape are difficult to develop and can accommodate only a small number of uses. As a result, their value per unit of area is generally lower than for packages of standard size shape. For example, triangular site does not provide itself to the sitting of a rectangular building. As a result, land is wasted or a triangular building is built with higher construction cost and useless interior space arrangements. Long narrow sites are

not desirable either; a lot 3 meter by 180 meter would not be practical as site for a single family residence, even though it contained 540 square meters as typical size (Ring and Dasso, 1977).

The shape of the site can reduce the development potential and design flexibility. This is especially right on smaller, and on narrow, linear sites that have higher edges to interior ratio than properties are more compact in shape (See figure 3.1). The larger ratio of edge increases the sites coverage to the surrounded landscape. If the site adjacent to a busy high way or other land use, for example, a linear or small site will considerably limit the site planner's ability to buffer the undesirable noise and visual impact (LaGro and James, 2008).

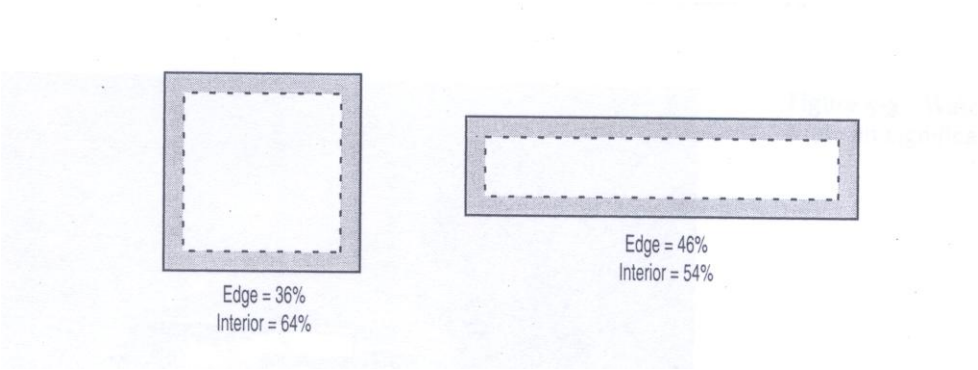

Figure 3.1: The relationship between land shape and edges to interior ratio for equal areas, (LaGro and James, 2008).

3.1.3.4. Topography

Topography is an important factor in most site planning decisions. Having a topographic analysis of the site is often essential. The U.S. geographical survey makes topographic

maps at several scales to provide information of biophysical and cultural context of a region. Three key attributes can be resulting from a topographic survey: The first one is elevation that affects both drainage system and as well as visibility; the second one is slope which affects site suitability for roads, walkways, buildings and other structure; the third one is aspect (See figure 3.2) which means the direction of the slope which it depends on the use of the site (LaGro and James, 2008).

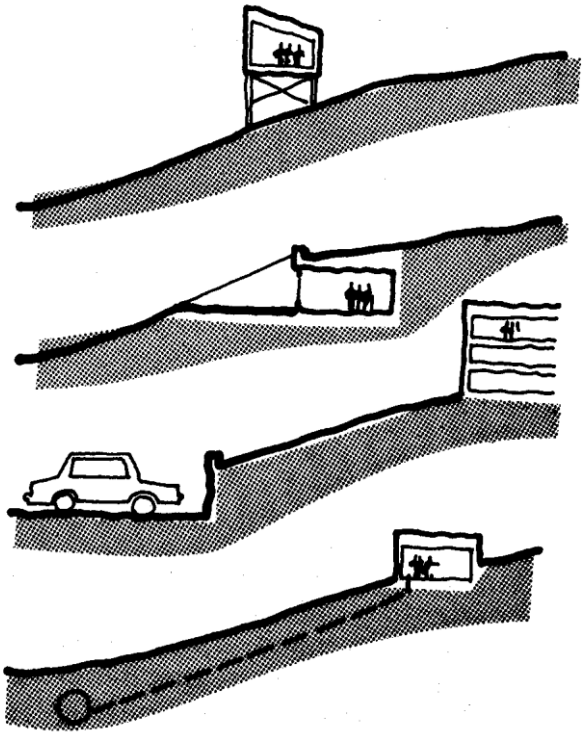

Figure 3.2: The relationship between the site use and slope (White, 1983)

The basic land form of a site is a visual and aesthetic resource that mainly influences the location of different land uses and functions (De Chiara and Koppelman, 1978). A developer performs a comprehensive market analysis in order to check the general topography of the land. This factor increases in importance with size of the development and when vacant land brought into productive use. Adequate analysis of the land

topography will also help determine the amount and the cost of grading and the best location for utilities. Market analysts should consult with an experienced land planner, soil engineer, or geologist who is familiar with the local area (Barrett and Blair, 1982). A careful analysis of site topography determines how much of its natural shape can be used for the design of structures and traffic roads. This analysis should be done in accordance with the surrounding land space (Kemper, 1979).

Site contours may be useful in the anticipation of many types of buildings. It provides significant degree of earth form to integrate the building and the exterior functions with the land. Sometimes contours and other surface features regulate where certain functions must be placed on the site like play areas and parking to avoid drainage problems with building and allow slope to connect building with sewer utility (White. 1983).

3.1.4. Utilities

Utilities include all services that are provided to a site by public utility companies (Shim et al., 1996). These essential services to the operation of the building include the gas, water, and electricity, sewer or sanitary system and telephone (Jaffe and Sirmans, 1982). Utilities are becoming difficult and of considerable concern in the planning, design, and financing of a project (Barrett and Blair, 1982). The availability of utilities and services provided by the community is a very important factor in the land use issues (Kemper, 1979).

New utility systems often account for an important share of a site's development cost. In the site range, it's important to understand where the public utility systems are located. This information is needed to find out the location where the new development will connect to these systems (LaGro and James, 2008). Utilities include the following factors:

3.1.4.1. Availability of Electrical Power

Connection into an obtainable, regular electrical system with sufficient capacity is preferred. Sites adjoining to the obtainable system will be rated highest. If a new electrical system is required for the site, then sites should be rated as to their potential to support or provide the system (Mearig et al., 1997).

3.1.4.2. Availability of Water Utilities

Water supply is available in cities and is usually provided by municipal utility company. The service area may not cover suburban areas, and alternatives must be provided. Agreements to share water supply system with nearby communities or new development areas may provide other feasible alternatives. Mainly, the factors determine the most feasible solution as initial and maintenance cost, capacity for growth, and risk of water shortage (Kemper, 1979).

Safe and economic public water supply system with maintenance standard is generally preferable to individual or community private supplies. First choice must be given to a site having access to a public system. In areas where a public supply is unavailable, it is necessary to notice that a local supply can be developed at a reasonable cost (De Chiara and Koppelman, 1978). Connection into an obtainable, reliable water supply system with sufficient capacity is preferred. Sites closest to the existing system would be rated highest (Mearig et al., 1997).

3.1.4.3. Availability of Sewage Utilities

Sewer service is usually supplied by one of the municipal authorities. Some cities make a single charge for the service, others charge on continue basis, and still others use both approaches (Kemper, 1979).

In the lack of accessible city supplied utilities, sewage treatment facilities will usually take the form of standard central treatment which is very costly or septic tank systems that require certain spatial requirements and soil conditions that may not exist on particular site (Barrett and Blair, 1982).

Connection into an obtainable, reliable waste and or sewer system with adequate capacity is preferred. Sites nearby the existing system will be rated highest. If a new sewer system is required for the site, then sites should be rated as to their potential to support or provide the system (Mearig et al., 1997).

3.1.4.4. Availability of Site Drainage

The drainage system must be designed to carry the amount of rain water that does not absorb by the ground (Kemper, 1979). Sites with good drainage system are easier to develop and maintain. Good drainage reduces the chance of water or ice collecting around a facility which could cause or leading to structural damage. It could also make general use and occupancy of the site difficult. Evaluation of this factor is based on natural features (Mearig et al., 1997).

3.1.4.5. Availability of Telephone Lines and IT Services

Availability of communication services is important as a site selection factor. Services could be extended to most sites providing a demand (De Chiara and Koppelman, 1978). If a site is not currently served by phone utilities the owner will have to pay in advance for the expansion of services to the site. The contact with the service provider usually specifies that the owner is being paid back his investment over a certain period of time. In many areas today underground utility wires are required to cover the community area (Kemper, 1979).

3.1.4.6. Alternative Energy Source

In some cases it may become feasible or cost effective to use the waste heat from an electrical generation plant, or some other low cost alternative energy source for heating

the new facility. These sources of energy mainly would be available at industrial cities where the site is located near a plant (Mearig et al., 1997).

3.1.5. Environmental Aspects

Environmental analysis includes the relationship between land use and the total environment both regional and local (Kemper, 1979). Overall environmental assessment of a site has become more important as clients' environmental awareness has increased (AIA, 2001).

Environmental considerations have always been an important aspect of the site planning process. They may include the analysis of macroclimates and microclimates. Over the years, general criteria for the selection of sites for different kinds of uses have developed from different sources. With such guide or check list, it is possible to evaluate most available sites and determine their suitability for proposed use (De Chiara and Koppelman, 1984). Environmental aspects include the following factors:

3.1.5.1. Quality of Air

The quality of air is important when selecting a building site. Smoke, dust, and odors may be serious troubles. Without being clear in a single investigation of the site, fair person who's familiar with the site of a long period should be asked. If there is any one of serious pollutants public health officials should be consulted.

Sources of smoke and dust include industry, rail road, and dumps. Dust may come from untreated dirt such as vacant areas, unplanted areas and recreation areas. The seriousness of that will depend on their intensity and rate. Investigations should cover the distance of the site from potential sources as well as the direction of wind current in all seasons. Control of smoke and odors should be obtained by legal regulations to make the protection of particular site possible. So the evaluation of the quality of air should be clearly identified (De Chiara and Koppelman, 1984).

Odors also may cause a problem with sites near large industrial areas. The direction of wind current is an important attribute considered in the planning phase. Before site development odor protection activities should be conducted (LaGro and James, 2008).

3.1.5.2. Orientation

The site should allow designs to take full advantage of available sun angles (Mearig et al., 1997). Orientation of the building to sun, wind, and vistas has basic considerations for site planning (See figure 3.3). Mainly it is important to protect the building from the hot summer sun and exposed to the sun's rays during the cold winter months. Taking advantages of summer light wind can reduce or eliminate the use for air conditioning (De Chiara and Koppelman, 1984).

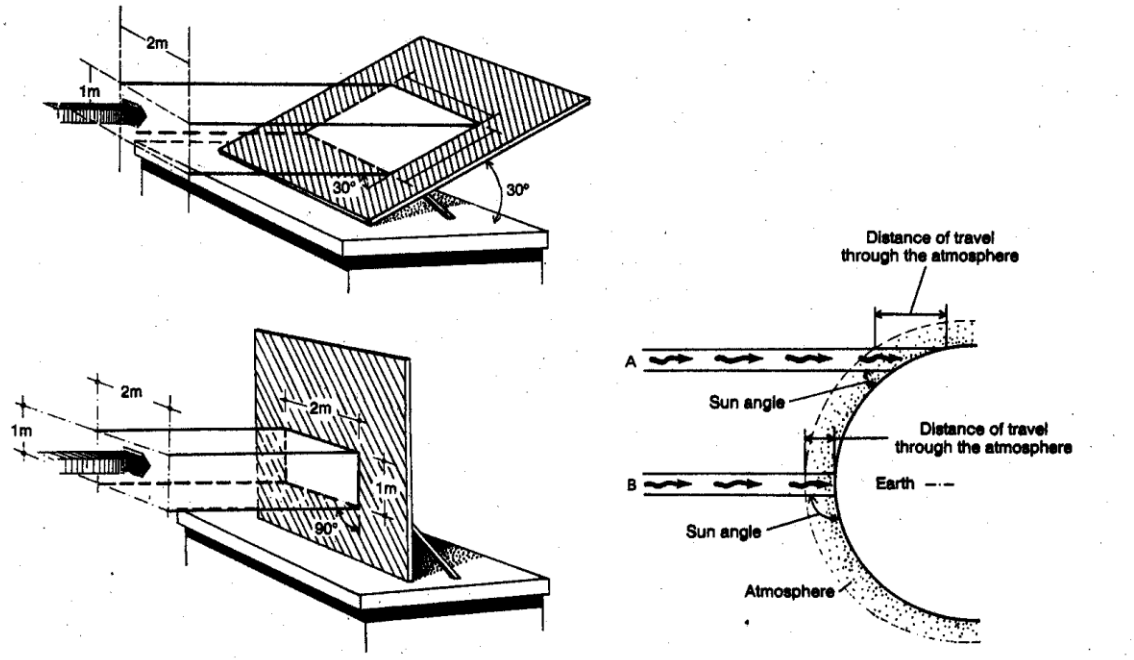

Figure 3.3: Influence of slope aspect on the intensity of solar radiation (LaGro and James, 2008).

3.1.5.3. Soil Condition

Physical, biological, and often cultural factors affect soil basis. Previous land use affects soil properties. Depending on the site's location and the proposed use, list of soil attributes that may consider include the following:

- Acidity (PH)
- Permeability
- Erosion potential
- Depth to seasonally high water table
- Depth to bedrock.

Subsurface conditions lead to the difficulty of excavation and construction activities. For large multistory buildings, foundations are constructed to greater depth. Soils vary usually in texture, productivity, and other attributes that influence the plant growth and development. Erosion occurs when plants cover is either removed or damaged during site cleaning and construction. Topsoil losses increase the cost of reestablishing vegetation on a site after construction (LaGro and James, 2008).

Perfect sites specifications include well graded, constant soils with high bearing pressure. Soil conditions allow the best economical foundation systems for more than 50 years of life cycle. Soil conditions which can adversely affect include construction sludge and clays, large surface or sub-surface organic and high water contents (Mearig et al., 1997).

Most of the characteristics that identify soils can be determined in the field. A few can be determined in the laboratory (De Chiara and Koppelman, 1978). Many land developers have purchased large area of land with the poor subsoil conditions, so the development cost will be high (Barrett and Blair, 1982). However, sites should be assessed for the quality of their soil based on identified conditions or on site investigations (Mearig et al., 1997).

3.1.5.4. Hydrology

Water circulates in the environment through rainfall, overland run, penetration, storage and evaporation. Groundwater moves by capillary action through the porous spaces between uncombined sand, gravel, rock, and between cracks (LaGro and James, 2008).

The influence of water on a site is complicated because the form of water is fluctuated and changed. Understanding how and under what conditions that change happens is part of site planner's duties. The influence and impact of surface water are not always dependent on the changes of nature (Brooks, 1988).

3.1.5.5. Proximity to Natural Hazards Area

Natural hazards include atmospheric, hydrologic and geologic actions affect humans, their structures, or their activities. These natural acts can present important risks that harm human life and property. Usually, little efforts can be conducted to control these critical issues. The valuable solution is to avoid development of areas that are most at risk. The cost of damage caused by natural hazards in United States has been estimated at an average of one billion dollar per week.

Until the late 1990s, the US government commonly allowed the reconstruction of buildings on sites that were damaged by natural failure. The year 2000 Building Code

changed the public policy of construction in areas of natural hazards. Government purchased some of these properties to reduce the risk (LaGro and James, 2008).

The natural hazards area of risk is abnormal to most types of real estate investments (Barrett and Blair, 1982). These sites have no inclination to damage facilities, and utilities from natural disasters, which would include acts of God such as earthquakes, avalanches, landslides, and volcanic activity.

Flooding potential from adjacent source of water must be considered. Sites near river or sea must be evaluated on how much and how often erosion takes place. Due to heavy rain area slopes which have been cleared of plants can also erode. Evaluation of this factor is based on natural features and the historical rate of these catastrophic hazards (Mearig et al., 1997).

3.1.5.6. Potential for Hazardous Materials

The site should be free of serious hazards to life or health. An adequate technique for measuring the seriousness of specific problems for the site selection is not available. Some hazards may not appear in a single inspection of the site. It is known that many hazards depend on season of the year, the time of day, the wind direction, or other weather factors (De Chiara and Koppelman, 1978).

Previous land use on a site may influence development suitability in different ways. For instance, a site used for industrial or commercial uses could show chemical and other

wastes remain on the site, either above or below ground. The large cost of waste cleaning had a disturbing effect on the redevelopment of commercial and industrial sites. The significant legal and financial risks of contaminated sites encouraged urban development by redirecting new development to sites on the urban areas. Especially in industrial regions of older cities, vacant contaminated sites reserved economic investment in the surrounding neighborhoods (LaGro and James, 2008).

So site should be free of indication of past use by industrial functions, free-for-all storage of items containing hazards materials that might cause several problems for developing process of the site (Mearig et al., 1997).

3.1.5.7. Climate

General climatic analysis related to site should be discussed. Concentration should also focus on the difference between normal and severe climatic conditions (Brooks, 1988). All climate and weather data are usually obtained from the local weather service centers. Interview must be conducted with appropriate people about weather conditions in an area (White, 1983). Mainly, these data include the following: (LaGro and James, 2008).

- Temperature (maximum, medium, and day/night temperature variations)
- Humidity (high, low and average)
- Wind (maximum, average velocity and direction)
- Rainfall (monthly total and maximum for any one day)
- Snowfall (monthly total and maximum for any one day)

- Solar radiation (monthly average)

In many cases, climate will not be a significant factor in the final selection of a site (Molnar, 1983). Both of small and large scale climatic conditions must be considered. For many sites climatic changes are mainly related to on-site factors like changes in topography, slope, orientation, vegetation, and the presence of water (De Chiara and Koppelman, 1978).

3.1.5.8. Tolerance for Background Noise

Site perceptual quality is affected by what people can see, hear and smell. Noise in the built environment is an element that may vary on a daily or a seasonal basis. Noise or lack of noise has significant impact on the quality and entertaining practice in outdoor environments.

Noise can be described in terms of intensity as loudness and frequency as field. Even sounds perceived as comfortably loud can be dangerous. Sound intensity is measured as sound pressure level (SPL) on decibel (dB) scale. Permanent hearing loss can be result from constant noise coverage equal to an average of 85 dB or higher for an eight hour period. However four hours of noise exposure at 88 dB is consider to provide the same noise does as eight hours at 85 dB. The occupation safety and health administration (OSHA) has set noise standard for the workplace. When noise in work environment is louder than 90 decibels for more than eight hours, employer must ensure that workers

wear earplugs or other hearing protection. Hearing protection is recommended for anyone exposed long time to 85 decibels or higher. Common noise sources and loudness levels, measured in decibels are as follows: (LaGro and James, 2008)

- shooting (140-170)
- Jet takeoff (140)
- Rock concert, chain saw (110-120)
- Diesel train, stereo head speakers (100)
- Motorbike, lawn mower (90)
- discussion (60)
- low voice (30-40)

Severe noise, sometimes with vibration, is produced by railroads, airports, street traffic heavy industry. Coverage of a site to noise pollution is a serious problem in both urban and suburban areas (De Chiara and Koppelman, 1978). The site and the surrounded area should be investigated for such potential sources of noise. Where they exist, their distance from the site and the presence of sound barriers should be determined.

Persons working close to airports, railroads, or industry and persons familiar with the site should be consulted. Streets noise should be considered as volume of traffic, traffic jams and stop intersections that require use of horns, gear shifting and breaking (De Chiara and Koppelman, 1984). Evaluation of this factor based on actual or anticipated noise level according to the standard is important (Site Selection Consultation, 2007).

3.1.6. Transportation Aspects

Transportation should document the present and anticipated zoning styles and plans. Transportation development of wide roads and any other trends that might affect the project in the future should be considered (White, 1983). Transportation analysis discusses the following factors that are associated with the process of site selection:

3.1.6.1. Availability of Public Transport

Policies and regulations are developed to make companies choose locations, where employees may rely on public transport for their trip to work (Aarhus, 2000). Location may be influenced by the important consideration of road, rail and air communications. Proximity to good public transport is important for office location in central areas (Keeping and shiers, 2004).

Transportation to job should be assessed in the beginning of the market analysis. Proximity to connecting streets, freeways, and public transportation are all important to a project evaluation process (Barrett and Blair, 1982). Sites nearby the transportation road will be most easily serviced (Mearig et al., 1997). The type, availability and rates of transportation require serious consideration (Molnar, 1983). Local and regional planning organizations and transportation agencies are good source of information because they are continually conducting traffic counts throughout areas (Barrett and Blair, 1982).

3.1.6.2. Ease of Transporting Construction Materials

Proximity to transportation road which can support heavy equipment can affect the usability of a site for construction. This factor mainly measures and evaluates the local impact of transporting materials to the site. Sites closest to the transportation road will be most easily serviced (Mearig et al., 1997).

3.1.6.3. Accessibility

Accessibility is an important factor to determine the site value. Most accessible site may receive higher rents and capital values (Keeping and Shiers, 2004). Access to the main streets is essential for site to facilitate movement between and among all sites. Without ready access to and from a site, transportation costs would become very high. The value of site that is inaccessible except by foot is usually evaluated as low assessment. Inaccessible site, as the snow area in Antarctic has no value for all purposes (Ring and Dasso, 1977). Accessibility level depends on the type of land use. It is one of the most important factors in planning for many industrial and commercial land uses (Kemper, 1979).

3.1.7. Financial Aspects

Real estate factors are specified with due credit to a particular site's success or failure, often, when it comes to sales (Fenker, 1999). Financial aspects concerns with economical aspects that affect the selection of a business site. It discusses the following factors:

3.1.7.1. Land Acquisition and Cost

Site should be available at reasonable cost (Mearig and Crittenden and Morgan, 1997). Generally, land value per unit area declines with increase in the size of lot and change in the method of area measurement. In country areas land values are lowered and size is measured in terms of acres or sections. In some cases land value increase, called plottage can be mentioned by bringing two smaller lots of land under a single ownership. Plottage means that the value of the lots, when combined, is greater than the sums of the values of each lot under separate owners. Plottage comes about because the larger unit of land can be used with lower cost than with smaller lots treated separately. Thus, combining two triangular business lots could provide a site able to accommodate rectangular building. The benefit, as against two triangular shaped buildings, would be lower construction cost and efficient space arrangements.

The value of a site is likely to be reduced by the market, where these services are not available. A site without water is valueless than a site with water. Generally, that means the value of site depends on its conditions and market condition. The price should reflect

the loss in the benefits because of the absence of the services. If improvements and services are available but not paid for, the value of the site is reduced by the amount of the unpaid cost (Ring and Dasso, 1977).

The buyer of land actually obtains two economic supplies, physical space and location. The value given to the land reflects the combination of the two produces. For the same price the buyer could obtain more land in less valuable location or could buy and sell quality for better location. The value of location varies for different land uses. Any land use constraint usually lowers the value of the site. Similarly, a zoning change permitting a higher land use always increases the property value (Kemper, 1979).

Land status is one of the main criteria for locating capital improvement. The site should be free of legal load, examined legal judgment and have a single owner. Land cost inflation can also sometimes be a problem because it can be increasing rapidly. This is not unusual when a large company is seeking land (Molnar, 1983).

3.1.7.2. Market Changes

The character of location can change over time, sometimes quickly and severely. This will help the developers to save marketplace changes and keep up-to-date market research. For example, the supply of development can affect the demand for buildings while changes in town planning policy can affect this supply. Developers need to display

economic and market growth potential in the given location with facts of factors such as current and future supply and demand (Keeping and Shiers, 2004).

Changes in the supply and demand conditions create the competition for any investments and cause a risk to most investments. Change in neighborhood conditions and traffic patterns because of the opening of a new street, and the development of new competition will affect the profitability in the local real estate market (Barrett and Blair, 1982).

3.1.7.3. Taxes

Taxes are one of the most important forces that influence the supply and demand for real estate. It may be positive or negative and is used as a governmental tool to force or prevent real estate development or to force the owner for particular use. In high population concentration vacant land is assessed and taxed with its contribution to overall real estate market value. Thus, it will motivate its use and indirectly put off the holding of vacant urban land for different purposes (Ring and Dasso, 1977).

The basic source of tax money is either the annual income or wealth of organizations and the greatest part consists of real estate (Kemper, 1979). Often, taxes could make the difference between profit and loss for the operation (Molnar, 1983). Taxes are also an important issue to find out neighborhood when considering site selection. Some regions have taxes on equipment, buildings, even phone lines, or added value taxes when property is improved (Rubin and Gail, 1993). The most important job on taxes is to make

reasonable and accurate estimate of future taxes at the proposed site. A key element of the evaluation process will be history of the state and local governments' tax incentives for company (Browning, 1980).

3.1.7.4. Development Cost

When client has an office building in mind and is looking for the best site for it, it may be necessary to survey the region, town, or neighborhood for available sites and then evaluate the potential sites in terms of requirements (AIA, 2001).

The process of development is more comprehensive in its nature. Site development can be socially, politically, and economically successful. It should be practiced by people who are familiar with community space requirements, real estate market trends and with community growth. Mainly, developers have experience in the real estate or are guided by real estate analysis, civil engineers, or consultants who have specialized in the highly complex field of land utilization.

Many direct costs must be evaluated when obtaining a site for land development. Site acquisition is only one part of these costs. A developer must also evaluate the hard cost, which include site preparation and utilities installation, and the soft cost which include site engineering, public approval, construction, and loan fees (Brueggeman and Fisher, 1997). Whenever land improvement is carried out, the field action is appropriately classified as land development (Ring and Dasso, 1977).

3.1.7.5. Labor Availability and Cost

Location analysis is also determined by labor characteristics. The quality of the labor force is critical issue, which is found to be significant in many studies (McCarthy and Atthirawong, 2003). Beside the cost of labor, the search team may study about the availability of skilled labor within a comfortable driving distance. The search team rated variables based on the statistics of continuous supply of skilled labor should be suitable for the proposed facility. Statistics on labor are available from local chamber of commerce (Singhvi, 1987).

3.2. Summary

This chapter discussed factors that affect the process of site selection of office building which were combined into seven categories, namely zoning regulations, geographical aspects, spatial configuration, environmental aspects, infrastructure, transportation aspects , and financial aspects. The following chapter of assessment of site selection factor for office buildings in Saudi Arabia includes a detailed statistical analysis to assign the degree of importance of each factor.

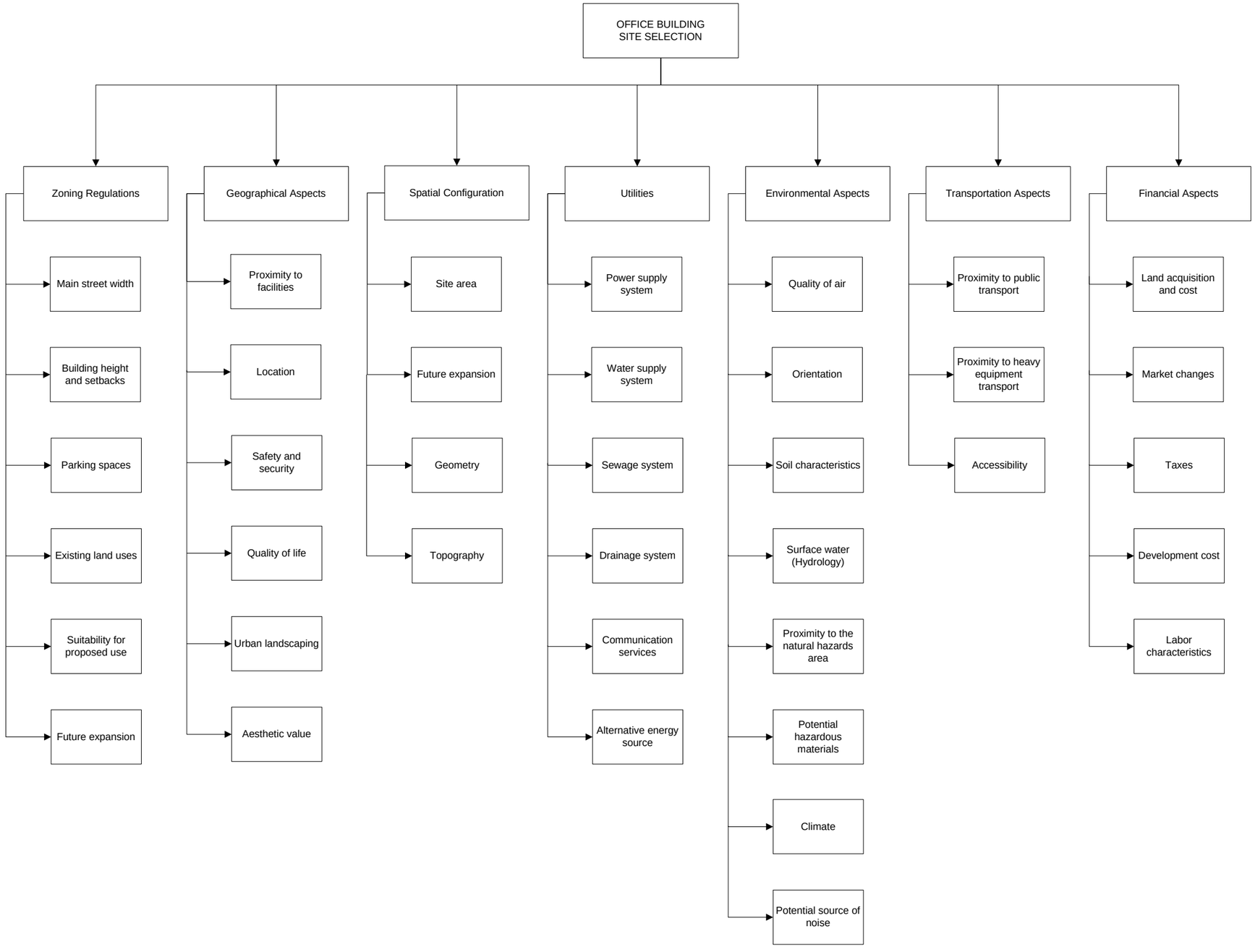

Figure 3.4: Site Selection Factors

CHAPTER FOUR

DATA COLLECTION & DATA ANALYSIS FOR OFFICE BUILDINGS SITE SELECTION IN SAUDI ARABIA

This chapter demonstrates the development of the questionnaire survey; its design administration and analysis. The questionnaire survey aims to rank office building site selection factors. The outcomes of this study will help in efficiently making decisions for site selection. To satisfy the second objective of the study this survey was conducted to obtain the ranks based on the degree of importance of the site selection factors that were discussed in the previous chapter. Data analysis was performed through the SPSS (Statistical Package for the Social Sciences) software and the results of the questionnaire survey are utilized to achieve the second objective of the study.

4.1. Data Collection

4.1.1. Questionnaire Design

The questionnaire design was designed in a simplified manner by structuring the identified site selection criteria as shown in Appendix-A. At the beginning of the questionnaire, a brief detail about the goal, basis and outcome of this survey was provided to respondents. All identified factors under the corresponding criterion as presented in the previous chapter were replicated in the questionnaire table to determine

their relative importance. The scale of relative importance used in this survey is mentioned as shown below:

- Very Important = 4
- Important = 3
- Somewhat Important = 2
- Not Important = 1

4.1.2. Questionnaire Administration

The most important task was to find respondents, who are experts in the area of site selection. Accordingly, many professional A/E consulting offices; real estate developers and commercial brokers were contacted to identify the appropriate expertise or experience in site selection. The questionnaire survey was conducted through personal interviews, mails and faxes. There are 152 organizations registered at the chamber of commerce in the Eastern Province, to satisfy the sample size at least 51 responses were required. To meet these requirement 64 questionnaires were sent to the randomly selected organizations that has experience in site selection. Out of the 64 questionnaires 58 acceptable responses were received to complete the questionnaire survey. Most of the responses were collected by mail.

4.2. Data Analysis and Results

SPSS provides a powerful statistical-analysis and data-management system in a graphical environment, using descriptive menus and simple dialog boxes. The feedback data of all the 58 responses was analyzed using SPSS to rank the selected factors. This data was fed into the SPSS to analyze the statistics and the relative importance of the factors. The results of the questionnaire survey are as follows:

4.2.1. Part One: General Information

The first part of the questionnaire consists of four questions; the first question is optional respondent information. The remaining three questions are in multiple choice formats as follows:

4.2.1.1. Respondent Years of Experience

The study considers the years of experience of the respondent; there were classified into four categories: less than five, five to ten, ten to twenty and more than twenty years.

For the A/E consultants it was found in the survey that (19.1%) of the respondents had less than five years experience. (23.8%) of respondents had five to ten years experience; (23.8%) of the respondents had ten to twenty years experience; (33.3%) of respondents had more than twenty years experience.

For the real estate developers it was found in the survey that (15.8%) of the respondents had less than five years experience; (31.6%) of respondents had five to ten years experience; (21%) of the respondents had ten to twenty years experience; (31.6%) of respondents had more than twenty years experience.

Similarly, for the commercial brokers it was found in the survey that (22.2%) of the respondents had less than five years experience; (44.4%) of respondents had five to ten years experience; (16.7%) of the respondents had ten to twenty years experience; (16.7%) of respondents had more than twenty years experience. Results are summarized in Fig 4.1

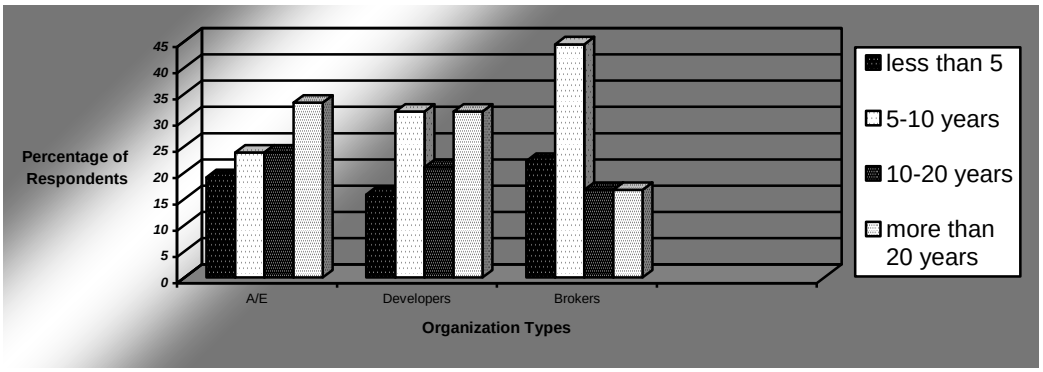

Figure 4.1: Respondent years of experience

4.2.1.2. Position of the Respondent

This question shows the position of each respondent. The survey indicated that (36%) of the respondents (21 out of 58) were classified as A/E consultants; (33%) of respondents

(19 out of 58) were classified as real estate developers and (31%) of respondents (18 out of 58) were classified as commercial brokers, results are summarized in Fig. 4.2.

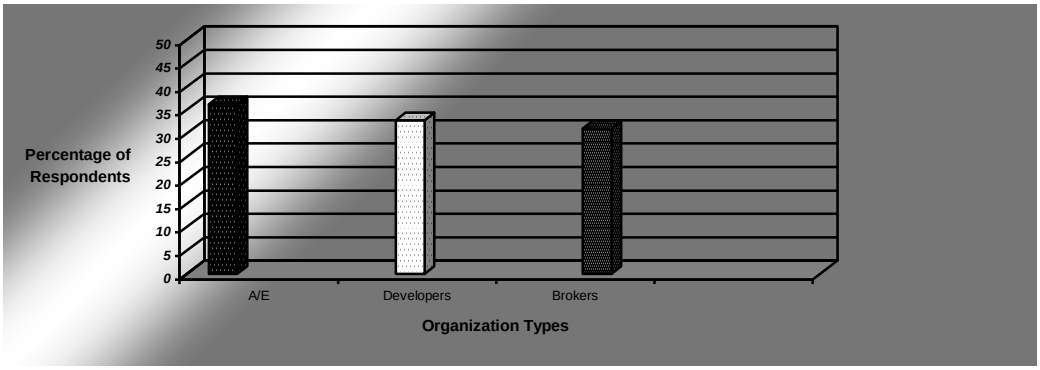

Figure 4.2: Position of the Respondent

4.2.1.3. Percentage of Work in Office Building Projects

This question provided the percentage of work in office building projects that the respondents were involved when compared to other types of projects. There were classified into four categories: (0 to 25%), (25 to 50%), (50 to 75%) and (75 to 100%). The survey indicated that for A/E consultants; 38% of the respondents were involved in 0-25% of office building projects, 33.4% of the respondents were involved in 25-50%, 14.3% of the respondents were involved in 50-75% and 14.3% of the respondents were involved in 75-100%.

For real estate developers; 47.5% of the respondents were involved in 0-25% of office building projects, 21% of the respondents were involved in 25-50%, 21% of the

respondents were involved in 50-75% and 10.5% of the respondents were involved in 75-100%.

For commercial brokers; 16.7% of the respondents were involved in 0-25% of office building projects, 38.9% of the respondents were involved in 25-50%, 27.7% of the respondents were involved in 50-75% and 16.7% of the respondents were involved in 75-100%. Results are summarized in Fig. 4.3.

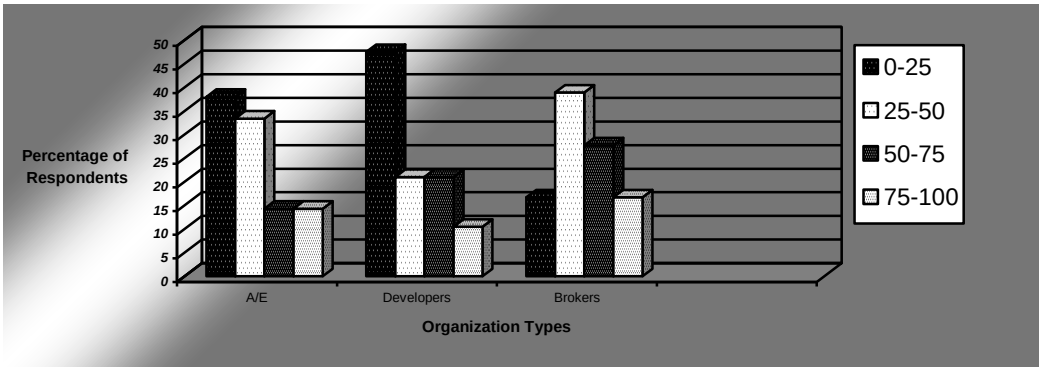

Figure 4.3: Percentage of work in office buildings site selection for different types of organizations

4.2.2. Part Two: Technical Information

The second part of the questionnaire consists of seven major criteria which contains the factors that affect the process of site selection for office buildings in Saudi Arabia. These factors were given criterion values rating from very important to not important. The respondents were asked to choose the most appropriate answer that describes the view of site selection in their organization, as follows:

- Very Important (4)
- Important (3)
- Somewhat Important (2)
- Not Important (1)

An average mean and standard deviation methods are used to accurately compute the data by the following ranges provided by the SPSS:

- Very Important (VI) 3.25 to 4.0
- Important (I) 2.50 to 3.24
- Somewhat Important (SW) 1.75 to 2.49
- Not Important (NI) 1.0 to 1.74

The analysis of the A/E consulting offices was performed to obtain the mean values and ranks of the factors. The data from all of the 21 responses was fed into the software and results were obtained immediately. The factors that received the first five ranks are availability of communication services, availability of adequate number of parking spaces, availability of adequate power supply system, site area in relation with functional spaces to be required and main street width and its affects on the location decision respectively. See table 4.1 for details of the results.

Factors	Mean	Frequency	Std. Dev.	Rank
1. Availability of communication services.	3.57	V. Important	0.811	1
2. Availability of adequate number of parking spaces.	3.48	V. Important	0.750	2
3. Availability of adequate, power supply system.	3.43	V. Important	0.811	3
4. Site area in relation with functional spaces to be required.	3.38	V. Important	0.669	4
5. Main Street Width and its affects on the location decision.	3.38	V. Important	0.740	5
6. Site suitability for the proposed facility.	3.38	V. Important	0.805	6
7. Proximity to a good public transport.	3.33	V. Important	0.730	7
8. Accessibility of ready access to/ from the site.	3.29	V. Important	0.717	8
9. Site investigations for potential hazardous materials.	3.29	V. Important	0.845	9
10. Availability of a site on free of legal load and at reasonable cost.	3.24	Important	0.831	10
11. Connection into an existing, reliable water supply system.	3.24	Important	0.995	11
12. Connection into an existing, reliable sewage system.	3.19	Important	0.928	12
13. Site allowance for future expansion.	3.14	Important	0.793	13
14. Existing land uses (residence, commercial, industrial).	3.14	Important	0.854	14
15. Site considerations for the quality of air.	3.14	Important	0.854	15
16. Evaluation of the potential sites in terms of the development cost.	3.14	Important	0.854	16
17. Site Location within the city fabrics.	3.10	Important	0.625	17
18. Market changes for supply and demand conditions.	3.10	Important	0.768	18
19. The characteristics of community and/ or location in terms of quality of life.	3.05	Important	0.740	19
20. Protective measures that may required for safety and security.	3.05	Important	0.805	20
21. Availability of site drainage system.	3.00	Important	0.949	21
22. Site investigations for the potential sources of noise.	2.95	Important	0.865	22
23. Site considerations for orientation to the sun and wind.	2.90	Important	0.831	23
24. Minimum and maximum building heights and setbacks.	2.90	Important	0.889	24
25. Proximity of transportation routes which can support heavy equipments for construction.	2.90	Important	0.889	25
26. The influence of surface water (hydrology).	2.90	Important	0.944	26
27. Using alternative energy source.	2.90	Important	1.044	27

28. Site proximity to the natural hazards area.	2.90	Important	1.136	28
29. Reasonable and accurate estimate of future taxes and incentive.	2.86	Important	0.727	29
30. Evaluation of how the site corresponds to future expansion.	2.86	Important	0.854	30
31. Proximity to facilities which shared between several offices.	2.71	Important	0.902	31
32. Adequate analysis of the site topography.	2.71	Important	1.007	32
33. Labor characteristics (Cost and availability of skilled labor).	2.71	Important	1.146	33
34. Aesthetic value of the site.	2.62	Important	0.973	34
35. Soil characteristics.	2.57	Important	0.926	35
36. General climatic conditions related to the site.	2.48	S.W Important	0.750	36
37. Assessment of urban landscaping.	2.48	S.W Important	0.928	37
38. Site geometry.	2.43	S.W Important	1.028	38

Table 4.1: A/E consulting offices ranking

Similarly, the analysis of the real estate developer was performed to obtain the mean values and ranks of the factors. The data from all of the 19 responses was fed into the software and results were obtained immediately. The factors that received the first five ranks are main street width, minimum and maximum building heights and setbacks, availability of adequate power supply system, accessibility of ready access to or from the site respectively. See table 4.2 for details of the results.

Factors	**Mean**	**Frequency**	**Std. Dev.**	**Rank**
1. Main Street Width.	3.84	V. Important	0.375	1
2. Minimum and maximum building heights and setbacks.	3.79	V. Important	0.419	2
3. Availability of adequate, power supply system.	3.74	V. Important	0.562	3
4. Availability of site drainage system.	3.63	V. Important	0.496	4
5. Accessibility of ready access to/ from the site.	3.63	V. Important	0.496	5

6. Connection into existing, reliable water supply system.	3.63	V. Important	0.684	6
7. Availability of adequate number of parking spaces.	3.63	V. Important	0.684	7
8. Site area in relation with functional spaces to be required.	3.58	V. Important	0.607	8
9. Availability of site on free of legal load and at reasonable cost.	3.58	V. Important	0.607	9
10. Availability of communication services.	3.53	V. Important	0.612	10
11. Connection into an existing, reliable sewage system.	3.53	V. Important	0.697	11
12. Proximity to a good public transport.	3.53	V. Important	0.905	12
13. Existing land uses (residence, commercial, industrial).	3.47	V. Important	0.612	13
14. Site suitability for the proposed facility.	3.47	V. Important	0.841	14
15. Site Location within the city fabrics.	3.37	V. Important	0.761	15
16. Site investigations for potential hazardous materials.	3.37	V .Important	0.895	16
17. Evaluation of the potential sites in terms of the development cost.	3.32	V. Important	0.820	17
18. Market changes for supply and demand conditions.	3.26	V. Important	0.733	18
19. Protective measures that may required for safety and security.	3.21	Important	0.631	19
20. The characteristics of community and/ or location in terms of quality of life.	3.21	Important	0.787	20
21. Site considerations for the quality of air.	3.16	Important	0.602	21
22. Evaluation of how the site corresponds to future expansion.	3.16	Important	0.765	22
23. Labor characteristics (Cost and availability of skilled labor).	3.11	Important	0.809	23
24. Site proximity to the natural hazards area.	3.11	Important	0.937	24
25. Adequate analysis of the site topography.	3.05	Important	0.621	25
26. The influence of surface water (hydrology).	3.05	Important	0.621	26
27. Proximity of transportation routes which can support heavy equipments for construction.	3.05	Important	0.780	27
28. Site investigations for the potential sources of noise.	3.00	Important	0.816	28
29. Using alternative energy source.	2.95	Important	0.524	29
30. Site geometry.	2.95	Important	0.621	30
31. Site allowance for future expansion.	2.95	Important	0.705	31
32. Assessment of urban landscaping.	2.89	Important	0.737	32
33. Site considerations for orientation to the sun and wind.	2.74	Important	0.872	33
34. Proximity to facilities which shared between	2.74	Important	1.098	34

several offices.				
35. Soil characteristics.	2.68	Important	0.820	35
36. Reasonable and accurate estimate of future taxes and incentive.	2.68	Important	0.946	36
37. General climatic conditions related to the site.	2.58	Important	0.838	37
38. Aesthetic value of the site.	2.47	S.W Important	0.964	38

Table 4.2: Real estate developers ranking

Similarly, the analysis of the commercial brokers was performed to obtain the mean values and ranks of the factors. The data from all of the 18 responses was fed into the software and results were obtained immediately. The factors that received the first five ranks are evaluation of the potential sites in terms of the development cost, protective measures that may required for safety and security, availability of adequate number of parking spaces, main street width, and accessibility of ready access to from the site respectively. See table 4.3 for details of the results.

Factors	**Mean**	**Frequency**	**Std. Dev.**	**Rank**
1. Evaluation of the potential sites in terms of the development cost.	3.72	V. Important	0.575	1
2. Protective measures that may required for safety and security.	3.67	V. Important	0.485	2
3. Availability of adequate number of parking spaces.	3.67	V. Important	0.594	3
4. Main Street Width.	3.61	V. Important	0.502	4
5. Availability of a site on free of legal load and at reasonable cost.	3.56	V. Important	0.616	5
6. Accessibility of ready access to/ from the site.	3.56	V. Important	0.629	6
7. Connection into an existing, reliable sewage system.	3.56	V. Important	0.705	7
8. Connection into an existing, reliable water supply system.	3.56	V. Important	0.705	8
9. Availability of communication services.	3.50	V. Important	0.618	9
10. Site considerations for the quality of air.	3.50	V. Important	0.618	10
11. Minimum and maximum building heights and	3.44	V. Important	0.616	11

setbacks.				
12. Proximity to a good public transport.	3.44	V. Important	0.705	12
13. The characteristics of community and/ or location in terms of quality of life.	3.39	V. Important	0.608	13
14. Site suitability for the proposed facility.	3.39	V. Important	0.778	14
15. The influence of surface water (hydrology).	3.39	V. Important	0.778	15
16. Site investigations for potential hazardous materials.	3.39	Important	0.850	16
17. Availability of site drainage system.	3.39	V. Important	0.850	17
18. Labor characteristics (Cost and availability of skilled labor).	3.33	V. Important	0.702	18
19. Proximity of transportation routes which can support heavy equipments for construction.	3.33	V. Important	0.767	19
20. Availability of adequate, power supply system.	3.33	V. Important	0.907	20
21. Site allowance for future expansion.	3.28	V. Important	0.470	21
22. Site geometry.	3.28	V. Important	0.669	22
23. Market changes for supply and demand conditions.	3.28	V. Important	0.752	23
24. Evaluation of how the site corresponds to future expansion.	3.28	V. Important	0.752	24
25. Proximity to facilities which shared between several offices.	3.28	V. Important	0.958	25
26. Adequate analysis of the site topography.	3.28	V. Important	1.018	26
27. Soil characteristics.	3.22	Important	0.732	27
28. Using alternative energy source.	3.22	Important	0.878	28
29. Site proximity to the natural hazards area.	3.22	Important	0.943	29
30. Site Location within the city fabrics.	3.17	Important	0.786	30
31. Site considerations for orientation to the sun and wind.	3.17	Important	0.924	31
32. Site area in relation with functional spaces to be required.	3.11	Important	0.583	32
33. Site investigations for the potential sources of noise.	3.11	Important	0.758	33
34. Existing land uses (residence, commercial, industrial).	3.00	Important	0.686	34
35. General climatic conditions related to the site.	2.89	Important	0.963	35
36. Reasonable and accurate estimate of future taxes and incentive.	2.83	Important	0.618	36
37. Aesthetic value of the site.	2.78	Important	0.878	37
38. Assessment of urban landscaping.	2.78	Important	0.943	38

Table 4.3: Commercial brokers ranking

For all of the 58 responses the mean values and the ranks were determined to establish the overall prioritization of the factors. The analysis was performed by using the SPSS software as well. The data from all of the 58 responses was fed into the software to obtain the results. The factors that received the first five ranks are main street width, availability of adequate number of parking spaces, availability of communication services, and availability of adequate power supply system and accessibility of ready access to or from the site. See table 4.4 for details of the results of the overall ranks and for complete view of all the results see table 4.5.

Site Selection Factors	**Overall Mean**	**Overall Frequency**	**Overall Rank**
1. Main Street Width.	3.61	V. Important	1
2. Availability of adequate number of parking spaces.	3.59	V. Important	2
3. Availability of communication services.	3.53	V. Important	3
4. Availability of adequate, power supply system.	3.50	V. Important	4
5. Accessibility of ready access to/ from the site.	3.49	V. Important	5
6. Connection into an existing, reliable water supply system.	3.48	V. Important	6
7. Availability of a site on free of legal load and at reasonable cost.	3.46	V. Important	7
8. Proximity to a good public transport.	3.43	V. Important	8
9. Connection into an existing, reliable sewage system.	3.42	V. Important	9
10. Site suitability for the proposed facility.	3.41	V. Important	10
11. Evaluation of the potential sites in terms of the development cost.	3.39	V. Important	11
12. Minimum and maximum building heights and setbacks.	3.38	V. Important	12
13. Site area in relation with functional spaces to be required.	3.36	V. Important	13
14. Site investigations for potential hazardous materials.	3.35	V. Important	14
15. Availability of site drainage system.	3.34	V. Important	15
16. Protective measures that may required for safety and security.	3.31	V. Important	16
17. Site considerations for the quality of air.	3.27	V. Important	17
18. The characteristics of community and/ or location in terms of quality of life.	3.22	Important	18
19. Market changes for supply and demand conditions.	3.21	Important	19

20. Site Location within the city fabrics (city centre, edges).	3.21	Important	20
21. Existing land uses (residence, commercial, industrial).	3.21	Important	21
22. Site allowance for future expansion.	3.12	Important	22
23. The influence of surface water (hydrology).	3.12	Important	23
24. Evaluation of how the site corresponds to future expansion.	3.10	Important	24
25. Proximity of transportation routes which can support heavy equipments for construction.	3.10	Important	25
26. Site proximity to the natural hazards area.	3.08	Important	26
27. Labor characteristics (Cost and availability of skilled labor).	3.05	Important	27
28. Using alternative energy source.	3.02	Important	28
29. Site investigations for the potential sources of noise.	3.02	Important	29
30. Adequate analysis of the site topography.	3.01	Important	30
31. Site considerations for orientation to the sun and wind.	2.94	Important	31
32. Proximity to facilities which shared between several offices.	2.91	Important	32
33. Site geometry.	2.89	Important	33
34. Soil characteristics.	2.83	Important	34
35. Reasonable and accurate estimate of future taxes and incentive.	2.79	Important	35
36. Assessment of urban landscaping.	2.72	Important	36
37. General climatic conditions.	2.65	Important	37
38. Aesthetic value of the site.	2.62	Important	38

Table 4.4: Ranking of the factors for the total sample

		A/E				Real Estate Developer				Commercial Broker				Overall Ranking		
	Site Selection Criteria and Factors	**Mean**	**Freq.**	**S.D.**	**Rank**	**Mean**	**Freq.**	**S.D.**	**Rank**	**Mean**	**Freq.**	**S.D.**	**Rank**	**Mean**	**Freq.**	**Rank**
I	**Zoning Regulations**															
1	Main Street Width	3.38	V. I.	0.74	5	3.84	V. I.	0.38	1	3.61	V. I.	0.5	4	3.61	V. I.	1
2	Minimum and maximum building heights and setbacks.	2.9	I.	0.89	24	3.79	V. I.	0.42	2	3.44	V. I.	0.62	11	3.38	V. I.	12
3	Availability of adequate number of parking spaces.	3.48	V. I.	0.75	2	3.63	V. I.	0.68	7	3.67	V. I.	0.59	3	3.59	V. I.	2
4	Existing land uses (residence, commercial, industrial).	3.14	I.	0.85	14	3.47	V. I.	0.61	13	3	I.	0.69	34	3.21	I.	21
5	Site allowance for future expansion.	2.86	I.	0.85	30	3.16	I.	0.77	22	3.28	V. I.	0.75	24	3.12	I.	22
6	Site suitability for the proposed facility.	3.38	V. I.	0.81	6	3.47	V. I.	0.84	14	3.39	V. I.	0.78	14	3.41	V.I.	10
II	**Geographical Aspects**															
7	Proximity to facilities which shared between several offices.	2.71	I.	0.9	31	2.74	I.	1.1	34	3.28	V. I.	0.96	25	2.91	I.	32
8	Site Location within the city fabrics (city centre, edges).	3.1	I.	0.63	17	3.37	V. I.	0.76	15	3.17	I.	0.79	30	3.21	I.	20
9	Protective measures that may required for safety and security.	3.05	I.	0.81	20	3.21	I.	0.63	19	3.67	V. I.	0.49	2	3.31	V. I.	16
10	The characteristics of community and/ or location in terms of quality of life.	3.05	I.	0.74	19	3.21	I.	0.79	20	3.39	V. I.	0.61	13	3.22	V. I.	18
11	Assessment of urban landscaping.	2.48	S.W.I	0.93	37	2.89	I.	0.74	32	2.78	I.	0.94	38	2.72	I.	36
12	Aesthetic value of the site.	2.62	I.	0.97	34	2.47	I.	0.96	38	2.78	I.	0.88	37	2.62	I.	38
III	**Spatial Configuration**															
13	Site area in relation with functional spaces to be required.	3.38	V. I.	0.67	4	3.58	V. I.	0.61	8	3.11	I.	0.58	32	3.36	V. I.	13
14	Evaluation of how the site corresponds to future expansion.	3.14	I.	0.79	13	2.95	I.	0.71	31	3.28	V. I.	0.47	21	3.1	I.	24
15	Site geometry.	2.43	S.W.I	1.03	38	2.95	I.	0.62	30	3.28	V. I.	0.67	22	2.89	I.	33
16	Adequate analysis of the site topography.	2.71	I.	1.01	32	3.05	I.	0.62	25	3.28	V. I.	1.02	26	3.01	I.	30
IV	**Utilities**															
17	Availability of adequate, power supply system.	3.43	V. I.	0.81	3	3.74	V. I.	0.56	3	3.33	V. I.	0.91	20	3.5	V. I.	4
18	Connection into an existing, reliable water supply system.	3.24	I.	1	11	3.63	V. I.	0.68	6	3.56	V. I.	0.71	8	3.48	V.I.	6
19	Connection into an existing, reliable sewage system.	3.19	I.	0.93	12	3.53	V. I.	0.7	11	3.56	V. I.	0.71	7	3.42	V.I.	9
20	Availability of site drainage system.	3	I.	0.95	21	3.63	V. I.	0.5	4	3.39	V. I.	0.85	17	3.34	V.I.	15
21	Availability of communication services.	3.57	V. I.	0.81	1	3.53	V. I.	0.61	10	3.5	V. I.	0.62	9	3.53	V. I.	3
22	Using alternative energy source.	2.9	I.	1.04	27	2.95	I.	0.52	29	3.22	I.	0.88	28	3.02	I.	28
V	**Environmental Aspects**															
23	Site considerations for the quality of air.	3.14	I.	0.85	15	3.16	I.	0.6	21	3.5	V. I.	0.62	10	3.27	V.I.	17
24	Site considerations for orientation to the sun and wind.	2.9	I.	0.83	23	2.74	I.	0.87	33	3.17	I.	0.92	31	2.94	I.	31
25	Soil characteristics.	2.57	I.	0.93	35	2.68	I.	0.82	35	3.22	I.	0.73	27	2.83	I.	34
26	The influence of surface water (hydrology).	2.9	I.	0.94	26	3.05	I.	0.62	26	3.39	V. I.	0.78	15	3.12	I.	23
27	Site proximity to the natural hazards area.	2.9	I.	1.14	28	3.11	I.	0.94	24	3.22	I.	0.94	29	3.08	I.	26
28	Site investigations for potential hazardous materials.	3.29	V. I.	0.85	9	3.37	I.	0.9	16	3.39	I.	0.85	16	3.35	V.I.	14
29	General climatic conditions.	2.48	S.W.I	0.75	36	2.58	I.	0.84	37	2.89	I.	0.96	35	2.65	I.	37
30	Site investigations for the potential sources of noise.	2.95	I.	0.87	22	3	I.	0.82	28	3.11	I.	0.76	33	3.02	I.	29
VI	**Transportation Aspects**															
31	Proximity to a good public transport.	3.33	V. I.	0.73	7	3.53	V. I.	0.91	12	3.44	V. I.	0.71	12	3.43	V.I.	8
32	Proximity of transportation routes which can support heavy equipments for construction.	2.9	I.	0.89	25	3.05	I.	0.78	27	3.33	V. I.	0.77	19	3.1	I.	25
33	Accessibility of ready access to/ from the site.	3.29	V. I.	0.72	8	3.63	V. I.	0.5	5	3.56	V. I.	0.63	6	3.49	V. I.	5
VII	**Financial Aspects**															
34	Availability of a site on free of legal load and at reasonable cost.	3.24	I.	0.83	10	3.58	V. I.	0.61	9	3.56	V. I.	0.62	5	3.46	V.I.	7
35	Market changes for supply and demand conditions.	3.1	I.	0.77	18	3.26	V. I.	0.73	18	3.28	V. I.	0.75	23	3.21	I.	19
36	Reasonable and accurate estimate of future taxes and incentive.	2.86	I.	0.73	29	2.68	I.	0.95	36	2.83	I.	0.62	36	2.79	I.	35
37	Evaluation of the potential sites in terms of the development cost.	3.14	I.	0.85	16	3.32	V. I.	0.82	17	3.72	V. I.	0.58	1	3.39	V.I.	11
38	Labor characteristics (Cost and availability of skilled labor).	2.71	I.	1.15	33	3.11	I.	0.81	23	3.33	V. I.	0.7	18	3.05	I.	27

Table 4.5: Overview of all the Results

Further, the data was analyzed to find the overall mean and ranks for the site selection categories which were presented in the previous chapter. Among these categories; the zoning regulations is at first rank and utilities obtained second rank while the third rank was achieved by transportation aspects. See table 4.6 for details of the results.

Criteria	Overall Mean of Criteria	Overall Rank of Criteria
1. Zoning Regulations	3.39	1
2. Geographical Aspects	3	7
3. Spatial Configuration	3.09	5
4. Utilities	3.38	2
5. Environmental Aspects	3.03	6
6. Transportation Aspects	3.34	3
7. Financial Aspects	3.18	4

Table 4.6: Ranking of the Categories for the total sample

4.3. Summary

This chapter has demonstrated the development of the questionnaire survey; its design administration and analysis. It also achieves the second objective of the study by obtaining the ranks based on the degree of importance of the site selection factors. The following chapter of development of methodology for office buildings site selection reveals in detail the development of methodology and the case study performed to demonstrate this methodology.

CHAPTER FIVE

DEVELOPMENT OF METHODOLOGY FOR OFFICE BUILDINGS SITE SELECTION

This chapter initiated with an extensive review of all relevant decision making processes for site selection. Based on this review and comparison of many available methods, it was noticed that the most viable method is the weighted evaluation method. Hence, the site selection methodology was developed using the weighted evaluation method. Some of the well-known Multi-Criteria Evaluation Methods are Weighted Evaluation Method (WEM), Preference Ranking Organization Method for Enrichment Evaluations (PROMETHEE II), Compromise Programming (CP), Elimination and Choice Translating Reality (ELECTRE II), and Analytical Hierarchy process (AHP) (Mahmoud & Garcia, 2000).

In Weighted Evaluation Method pair-wise comparisons are performed to compare the factors in order to obtain the degree of importance. The selected factors presented in Chapter 3 were utilized to perform the pair-wise comparisons. Five experts were selected to perform the pair-wise comparisons based on their knowledge and experience in the real estate management in the Eastern Province region of Saudi Arabia. The weight of the factors was obtained by the evaluation of the criteria scoring matrix. Finally, a case study was conducted using the analysis matrix to select the best site for office building out of

four proposed sites. These four proposed sites are located at different commercial areas in the main cities of the Eastern Province region.

5.1. Weighted Evaluation

Weighted evaluation is an organized methodology that will help verify our own decisions and assist consumers in making the best decision for their situation. It involves proper consideration of all possible criteria and alternatives (Luther, 2003).

Consider the questions we have to answer and the advice we have to provide in the site selection. As abovementioned, the questions usually involve several criteria (factors) and alternatives. The weighted evaluation methodology can be a very useful tool to assist in decision making. It enables us to give more consideration to necessary aspects of the decision. The solution becomes a systematic selection rather than a random decision making process (Luther, 2003). The weighted evaluation worksheet is broken down into two parts: the Criteria scoring matrix using pair-wise comparison and the Analysis/evaluation matrix.

5.1.1. Criteria Scoring Matrix

Important criteria (factors) in the selection of alternatives are identified on the criteria scoring matrix and compared to each other for relative importance using pair-wise comparison. The comparison process is limited to two elements at a time. Preference of

one criterion over another is established, and a numerical score of 1 to 4 is given to the preferred criterion. A key to the score definitions is identified on the worksheet. The sum of each criterion's scores is tabulated into a raw score. The raw score is converted into a weight of importance factor on a scale of 1 to 10.

5.1.2. Analysis Matrix

Possible alternatives (solutions) are listed in the Analysis Matrix and compared to each of the criteria (factors) from the Criteria Scoring Matrix. A different numerical score of 1 to 5 is established for the alternative to criteria comparison. This score is multiplied by the weight of importance factor in order to establish an adjusted subtotal score. The sum of all alternative-to-criteria comparison (adjusted subtotal) scores is tallied to give a final numerical total score that ranks one alternative to another. Fig. 5.1 illustrates weighted evaluation steps.

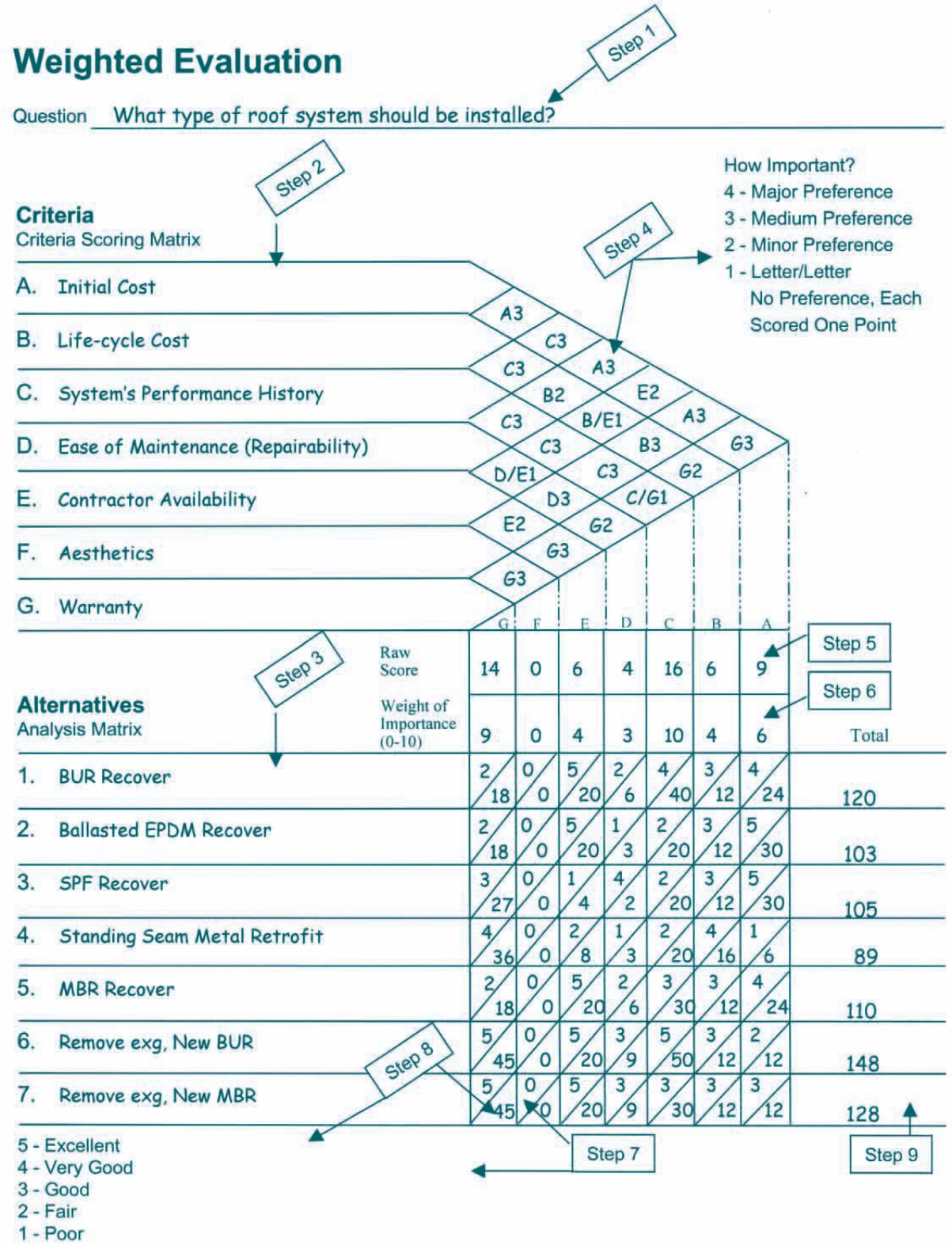

Figure 5.1: Weighted Evaluation Steps (Mock, 2003)

5.2. Eigenvalue Method for Consistency of Data Analysis

Ishizaka and Lusti (2006) discusses on the argument of deriving the best priorities method. Three methods have been mentioned in their discussion such as mean of normalized values method, the eigenvalue approach and the geometric mean method. Since the eigenvalue method is unclear and inefficient, the power method is applied to the eigenvalue method for the clarification and efficiency. The power method is a numerical method to calculate the maximal eigenvector which relies on an iterative process. This method is implemented through MatLab program shown in Appendix D. An example of this analysis is as follows:

The method of checking consistency of criteria scoring matrix is precise and complete. In order to explain this analysis process, three site selection factors are taken as an example (Meacham, 2000) shown in Table 5.1.

Factors	Degree of Importance scale 1-4	Factors
Main Street Width (MSW)	(2)*	Accessibility To Site(ATS)
Main Street Width (MSW)	3	Existing Land uses (ELU)
Accessibility To Site(ATS)	4	Existing Land uses (ELU)

* Number with parentheses represents the reciprocity of that number.

Table 5.1: Pair-wise Comparisons between factors

To check the consistency of these three factors, pair-wise comparisons are entered in a three by three matrix shown in Figure 5.2. The diagonal of the matrix consists of all numeral ones, as a factor is equally important to itself. Once a preference is stated it is

assumed that the reciprocal relationship also holds, and the mathematical reciprocal is used in the matrix. The mathematics of the method allows a non-reciprocal relationship to exist; however, reciprocity usually holds for a 'rational' decision-maker.

	MSW	**ATS**	**ELU**
MSW	1/1	1/2	3/1
ATS	2/1	1/1	4/1
ELU	1/3	1/4	1/1

Figure 5.2: The Original Matrix Developed from the Table 5.1

In order to simplify calculations, the values in Figure 5.2 are converted to decimal values, as shown in Figure 5.3. Then, the original matrix is squared (M^2) using the matrix algebra, with the results shown in Figure 5.4.

1.0000	0.5000	3.0000
2.0000	1.0000	4.0000
0.3333	0.2500	1.0000

Figure 5.3: The Original Matrix – Expressed in Decimal Values

3.0000	1.7500	8.0000
5.3332	3.0000	14.0000
1.1666	0.6667	3.0000

Figure 5.4: Matrix Obtained by Mathematically Squaring the Matrix

The eigenvector of the matrix in Figure 5.4 is then calculated by summing the rows of the matrix, calculating the overall sum of all values in the matrix and normalizing the rows sums by the matrix total sum (Eigenvalue). The calculated eigenvector is a column vector, and is seen on the right in Figure 5.5.

3.0000	+	1.7500	+	8.0000	**= 12.7500**	**0.3194**
5.3332	+	3.0000	+	14.0000	**= 22.3332**	**0.5595**
1.1666	+	0.6667	+	3.0000	**= 04.8333**	**0.1211**
				Total	**= 39.9165**	**1.0000**

Figure 5.5: Matrix Obtained by Mathematically Squaring the Matrix

The process of squaring the matrix is iterated until the change in the resulting matrix eigenvector from iteration to iteration is acceptably small. This change or difference will represent the inconsistency in the results obtained. For the analysis of this research study, a 5% inconsistency is assumed (Saaty, 1980). Which means, an inconsistency of < 0.05 assumed. Figure 5.6 shows the calculated eigenvector after second squaring (M^3) of the

original pair-wise comparison matrix (See Figure 5.3). Figure 5.7 shows the difference between the eigenvectors calculated after the first iteration.

9.1667	+	5.2500	+	24.0000	= **38.4167**	**0.3195**
16.0000	+	9.1667	+	42.0000	= **67.1667**	**0.5586**
3.5000	+	2.0000	+	9.1667	= **14.6667**	**0.1220**
				Total	= **39.9165**	**1.0000**

Figure 5.6: Matrix Obtained by Mathematically Squaring the Matrix

0.3194	—	**0.3195**	=	— **0.0001**
0.5595	—	**0.5586**	=	**0.0009**
0.1211	—	**0.1220**	=	— **0.0009**

Figure 5.7: Matrix Obtained by Mathematically Squaring the Matrix

Hence, it can be observed from Figure 5.7 that the results are satisfying the inconsistency of <0.05. For this example, in a single iteration the desired consistency was obtained. Performing further iterations will have no benefit as the required consistency has obtained. But in another case, if the inconsistency is higher than assumed then more iterations are required until the desired consistency is obtained.

MATLAB program was written to facilitate the analysis process mentioned above; since, it is not easy to manually determine the consistency for 38x38 factors. The concept or logic utilized in this program is power method applied to the eigenvalue method to perform the pair-wise comparisons as the steps of the above example. The outputs of the program result is indicated the inconsistency ranging between (-0.0007) and (0.0009) which is less than 0.05 obtained in one iteration, so that means the total results are consistent. For more details about the program and the results obtained see Appendix D.

5.3. Case Study

5.3.1. Criteria Scoring Matrix

This methodology is used to compare the degree of importance of the factors in order to determine the weight of each factor. To develop this matrix each of the 38 factors were assigned a letter of the alphabet [Appendix- C] and then compared with each of the other factor based on the preference of the A/E consulting office, commercial broker and/or real estate developer for each particular office building project. Five experts were selected based on their experience and involvement in different types of organizations to perform the pair-wise comparisons. A thorough explanation was given to these experts on this methodology and performing pair-wise comparisons. The importance of one factor over another can be major, 4; medium, 3; minor, 2; and slight, 1 as shown in Table 5.2.

Evaluation terms	Important
Major Importance	4
Medium Importance	3
Minor Importance	2
Slight, No Importance	1

Table 5.2: Importance of Evaluation Terms

After all pair-wise comparisons are made in the criteria scoring matrix; the raw score of each factor is totaled by summing the assigned letters in the matrix. Then the raw score were adjusted to the scale of 1-10, with 10 being assigned to the factor with the highest raw score and the other factors adjusted accordingly as shown in Table 5.3.

No	Factors	Raw Score	Assigned Weight	Rank
A	Main Street Width.	99	8.05	6
B	Minimum and maximum building heights and setbacks resulting.	95	7.72	8
C	Availability of adequate number of parking spaces.	66	5.37	14
D	Existing land uses (residence, commercial, industrial).	70	5.69	13
E	Evaluation of how the site corresponds to future expansion.	58	4.72	16
F	Site suitability for the proposed facility.	102	8.29	4
G	Proximity to facilities which shared between several offices.	33	2.68	26
H	Site Location within the city fabrics (city centre, edges)	38	3.09	20
I	Protective measures that may required for safety and security.	7	0.57	37
J	The characteristics of community and/ or location in terms of quality of life.	10	0.81	34
K	Assessment of urban landscaping.	18	1.46	30
L	Aesthetic value of the site.	12	0.98	33
M	Site area in relation with functional spaces to be required.	101	8.21	5
N	Site allowance for future expansion.	15	1.22	31
O	Site geometry.	8	0.65	36

P	Adequate analysis of the site topography.	7	0.75	35
Q	Availability of adequate, power supply system.	87	7.07	9
R	Connection into an existing, reliable water supply system.	96	7.80	7
S	Connection into an existing, reliable sewage system.	76	6.18	11
T	Availability of site drainage system.	32	2.60	28
U	Availability of communication services.	82	6.67	10
V	Using alternative energy source.	2	0.16	38
W	Site considerations for the quality of air.	38	3.09	20
X	Site considerations for orientation to the sun and wind.	38	3.0 9	20
Y	Soil characteristics.	38	3.09	20
Z	The influence of surface water (hydrology).	14	1.14	32
A*	Site proximity to the natural hazards area.	38	3.09	20
B*	Site investigations for potential hazardous materials.	37	3.01	25
C*	General climatic conditions.	28	2.28	29
D*	Site investigations for the potential sources of noise.	49	3.98	19
E*	Proximity to a good public transport.	75	6.09	12
F*	Proximity of transportation routes which can support heavy equipments for construction.	59	4.79	15
G*	Accessibility of ready access to/ from the site.	109	8.86	3
H*	Availability of a site on free of legal load and at reasonable cost.	123	10	1
I*	Market changes for supply and demand conditions.	52	4.23	17
J*	Reasonable and accurate estimate of future taxes and incentive.	50	4.07	18
K*	Evaluation of the potential sites in terms of the development cost.	111	9.02	2
L*	Labor characteristics (Cost and availability of skilled labor).	33	2.68	26

Note: The raw scores have been rounded off to the nearest whole number for the purpose of avoiding errors in decimals calculations.

Table 5.3: Selected Factors with Relative Weight

These results of relative weights were verified through the MatLab program iterations performed based on the power method applied to the eigenvalue method, which indicated the consistency of the results. In this process, initially, the average scores of the pair-

wise comparisons are given to obtain the original matrix. The first iteration will compare the eigenvectors of the first squaring and the second squaring. If consistency is satisfied which is less than 0.05 then the resulting eigenvector determines the weightings. Otherwise, it continues to perform the iterations by raising the exponential power of the original matrix and comparing the eigenvectors. Iterations are executed until the desired consistency is reached. Finally, the relative weights, its consistency and the number of iterations executed in this process will be displayed.

5.3.2. Analysis Matrix

Once the factors have been weighted, then the four proposed sites (alternatives) were evaluated against all of the factors. At this stage, all the alternative sites A, B, C and D were given scores against each one of 38 factors. To express how much these sites meet the minimal needs or basic function of the user or owner, the scoring system is used in this analyses matrix which involves assigning 1-5 points on a scale of poor to excellent Table 5.4.

Evaluation terms	**Important**
Excellent	5
Very good	4
Good	3
Fair	2
Poor	1

Table 5.4: Site evaluation terms

The ranks of each alternative were multiplied by corresponding weights of the factors, and the resulting scores entered into the matrix shown in Table 5.5. The total scores were then determined for each alternative and Table 5.6.

Evaluation Criteria	**Assigned weight**	**Alternatives**							
		Site A		**Site B**		**Site C**		**Site D**	
		Rank	**Score**	**Rank**	**Score**	**Rank**	**Score**	**Rank**	**Score**
Main Street Width.	8.05	2	16.1	4	32.2	4	32.2	2	16.1
Minimum and maximum building heights and setbacks	7.72	5	38.6	5	38.6	3	23.16	4	30.88
Availability of adequate number of parking spaces.	5.37	4	21.48	2	10.74	4	21.48	5	26.85
Existing land uses (residence, commercial, industrial).	5.69	3	17.07	3	17.07	3	17.07	3	17.07
Evaluation of how the site corresponds to future expansion.	4.72	3	14.16	4	18.88	2	9.44	3	14.16
Site suitability for the proposed facility.	8.29	5	41.45	5	41.45	5	41.45	5	41.45
Proximity to facilities which shared between several offices.	2.68	3	8.04	4	10.72	4	10.72	3	8.04
Site Location within the city fabrics (city centre, edges)	3.09	4	12.36	3	9.27	3	9.27	4	12.36
Protective measures that may required for safety and security.	0.57	5	2.85	5	2.85	4	2.28	4	2.28
The characteristics of community and/ or location in terms of quality of life.	0.81	5	4.05	5	4.05	4	3.24	5	4.05
Assessment of urban landscaping.	1.46	3	4.38	3	4.38	4	5.84	4	5.84
Aesthetic value of the site.	0.98	3	2.94	4	3.92	5	4.9	4	3.92
Site area in relation with functional spaces to be required.	8.21	5	41.05	5	41.05	5	41.05	5	41.05
Site allowance for future expansion.	1.22	4	4.88	2	2.44	2	2.44	3	3.66
Site geometry.	0.65	3	1.95	4	2.6	4	2.6	4	2.6
Adequate analysis of the site topography.	0.75	4	3	5	3.75	5	3.75	4	3
Availability of adequate, power supply system.	7.07	5	35.35	5	35.35	5	35.35	5	35.35
Connection into an existing, reliable water supply system.	7.80	5	39	5	39	5	39	5	39

Connection into an existing, reliable sewage system.	6.18	4	24.72	4	24.72	4	24.72	4	24.72
Availability of site drainage system.	2.60	4	10.4	3	7.8	3	7.8	2	5.2
Availability of communication services.	6.67	5	33.35	5	33.35	4	26.68	4	26.68
Using alternative energy source.	0.16	1	0.16	1	0.16	1	0.16	1	0.16
Site considerations for the quality of air.	3.09	4	12.36	4	12.36	4	12.36	4	12.36
Site considerations for orientation to the sun and wind.	3.09	5	15.45	4	12.36	4	12.36	3	9.27
Soil characteristics.	3.09	3	9.27	4	12.36	4	12.36	3	9.27
The influence of surface water (hydrology).	1.14	4	4.56	4	4.56	4	4.56	4	4.56
Site proximity to the natural hazards area.	3.09	2	6.18	1	3.09	1	3.09	1	3.09
Site investigations for potential hazardous materials.	3.01	1	3.01	1	3.01	2	6.02	1	3.01
General climatic conditions.	2.28	3	6.84	3	6.84	3	6.84	3	6.84
Site investigations for the potential sources of noise.	3.98	4	15.92	2	7.96	4	15.92	3	11.94
Proximity to a good public transport.	6.09	4	24.36	5	30.45	4	24.36	3	18.27
Proximity of transportation routes which can support heavy equipments for construction.	4.79	3	14.37	3	14.37	3	14.37	4	19.16
Accessibility of ready access to/ from the site.	8.86	4	35.44	5	44.3	3	26.58	4	35.44
Availability of a site on free of legal load and at reasonable cost.	10	5	50	4	40	3	30	4	40
Market changes for supply and demand conditions.	4.23	2	8.46	3	12.69	3	12.69	3	12.69
Reasonable and accurate estimate of future taxes and incentive.	4.07	1	4.07	1	4.07	1	4.07	1	4.07
Evaluation of the potential sites in terms of the development cost.	9.02	1	9.02	1	9.02	1	9.02	2	18.04
Labor characteristics (Cost and availability of skilled labor).	2.68	1	2.68	1	2.68	1	2.68	1	2.68
Total score		599.33		604.47		561.88		575.11	

Table 5.5: Total Score for Alternative Sites

No.	Site Alternatives	Total Score	Rank
1	Site (B)	604.47	1
2	Site (A)	599.33	2
3	Site (D)	575.11	3
4	Site (C)	561.88	4

Table 5.6: Analysis Matrix Result Ranking of Sites

5.4. Summary

This chapter deals with the development of site selection methodology to satisfy the third objective of the study using the weighted evaluation method. It also represents how the case study was conducted using the analysis matrix to select the best site for office building out of four proposed sites. The following chapter of conclusions and recommendations provides the overall summary and results of this work, and some helpful recommendations to develop a useful site selection process.

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.1. Summary of this Research Study

This research is divided into six chapters. The following is the summary of this research:

The first chapter (Introduction) presents an introduction to the research area that contains knowledge about office building site selection in Saudi Arabia, the importance of the best site for office building facilities. It presents the research problem, the significance of the study, research objectives, the scope and limitations of the research, the methodology set to achieve the stated objectives and thesis organization.

The second chapter (Domain Analysis and Description) presents an overview of the current situation provided for site selection. The previous studies are also included to provide a support for carrying out this research and help in shaping this research in a very effective form.

The third (Office Buildings Site Selection Factors) chapter investigated the influential factors that affect the process of site selection for office buildings in Saudi Arabia based

on the research activities conducted in the previous chapter, selected and classified factors under categories where commonalities are shared.

The Forth chapter (Data Collection and Data Analysis for office building in Saudi Arabia) demonstrates the development of the questionnaire survey; its design administration and analysis. The questionnaire survey aims to rank office building site selection factors. It also helped in efficiently making decisions for site selection. To satisfy the second objective of the study this survey was conducted to obtain the ranks based on the degree of importance of the site selection factors that were discussed in the previous chapter. Data analysis was performed through the **SPSS** (Statistical Package for the Social Sciences) software and the results of the questionnaire survey are utilized to achieve the second objective of the study.

The fifth chapter (development of methodology for office building site selection) deals with the development of site selection methodology to satisfy the third objective of the study using the weighted evaluation method. The selected factors presented in chapter three were utilized to perform weighted evaluation. The weight of the factors was obtained by the evaluation of the criteria scoring matrix. Then the consistency of the matrix is tested through MatLab program. Finally, a case study was conducted using the analysis matrix to select the best site for office building out of four proposed sites.

6.2. Conclusions

This research was a reasonably broad study utilizing the site selection criteria for office building as an approach and the conclusions derived from this research are mentioned as follows:

1. There are various factors responsible for appropriate site selection of office building. However, 38 most valuable or relevant factors were selected based on the previous studies, experts' research and interviews.
2. A questionnaire survey was developed to assess the relative degree of importance for each of the identified factors among three different types of organizations. A total of 58 responses were obtained where a minimum sampling size of 51 responses was required. It was found that the degree of importance of the factors is changing with change in the type of organization, since people working in different organizations have dissimilar scenarios and mindsets. The respondents indicated that: 21 A/E offices [Availability of communication services (Highest rank) & Site geometry (Lowest rank)], 19 Real Estate Developers [Main street width (Highest rank) & Aesthetic value of the site (Lowest rank)] and 18 Commercial Brokers [Evaluation of the potential sites in terms of the development cost (Highest rank) & Assessment of urban landscaping (Lowest rank)].
3. To generalize the methodology and establish proper decision making process the weighted evaluation method was utilized. This method allows for identifying the weights given to each factor, and consequently ranking of all factors. Five experts

were selected to consider all possibilities and aspects in the decision making process of site selection.

4. The first step in weighted evaluation is the criteria scoring matrix evaluation which shows that Availability of a site on free of legal load and at reasonable cost attained the first rank followed by Evaluation of the potential sites in terms of the development cost and the last rank was obtained by Using alternate energy source.
5. The results of relative weights obtained through evaluation of criteria scoring matrix were verified through the MatLab program iterations performed based on the power method applied to the eigenvalue method. A tolerance of 5% inconsistency was assumed. The program indicated the inconsistency results ranging between (-0.0007) and (0.0009). Thus, the total results are consistent.
6. A step forward in weighted evaluation is to perform the evaluation in alternative analysis matrix method. This evaluation was performed based on the response of site selection personnel who had thorough understanding of all the aspects and conditions of the 4 sites being considered for an office building. Detailed insight and systematic approach has assisted in correctly assessing the site selection factors in this case study.
7. Established factors, weightings and the methodology helped in effortlessly carrying out the assessment process of the case study. Results of the case study shows that the Site B is most suitable for the office building with a score of 604.47, which is followed by Site A with a score of 599.33.

8. It was found that weighted evaluation is one of the best decision making process as it involves proper consideration of all possible criteria and alternatives.
9. The experts were satisfied with the evaluation and the ranks of the factors obtained.
10. Hence, this phenomenon has proved to be very reliable in evaluating sites for office buildings. This methodology is also subject to the qualitative evaluation performed by the site selection personnel.
11. There is enormous number of parameters affecting the site selection process, but to select and weight the most influential factors as per the needs is most important.

6.3. Recommendations

Although there are numerous ways for assessing the factors, they can generally be reduced to a two types of requirements: properly determining weightings and appropriately evaluating the sites as per the conditions. Some of the general recommendations that could help in establishing decision making process of office building site selection are mentioned as follows:

1. Real Estate developer in eastern province of Saudi Arabia are encouraged to consider the results revealed by this research to have better understating when dealing with the decision making for site selection.

2. The methodology used here is not limited to only office building site selection but as per the factors and nature of organizations it can be utilized accordingly.
3. A model should be developed to test the results of this decision making process prior to implementation. It is also recommended to develop or utilize suitable software to perform the matrix evaluations.
4. Even in urgencies an appropriate site can be selected if this technique is applied effectively by considering only top ranked site selection factors.

6.4. Prospects for Future Research

The following are the opportunities to conduct future research in a related area to this thesis:

1. The selection and the arrangement of the factors can be performed based on a survey, wherein, the experts shall select and arrange the most essential factors from a comprehensive list and then determine the relative importance by pair-wise comparisons.
2. Development of user-friendly software that can be used by decision makers for a quick and easy way of site selection.
3. The best opportunity is to apply the concept and methodology of this study to other types of facilities, organizations and industries. Particularly, the areas where there is more demand for such methodologies in public sectors.

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APPENDIX – A (Questionnaire)

Subject: Study of Site Search and Selection Criteria for Office Buildings in Saudi Arabia

A study is being conducted on the factors affecting site search and selection of office buildings in Saudi Arabia.

The objective of this survey is to obtain your valuable input on how do you perceive the importance of the identified factors. The information obtained through this questionnaire will stringently be used for educational purposes.

PART I

1. **Respondent Information:**

Name (Optional)	
Job Title	
Telephone No. (Optional)	
Facsimile (Optional)	
E-Mail Address (Optional)	
Organization Address (Optional)	

2. **How many years of experience you have in your work:**

Less than 5 years		5-10 years	
10-20 years		Over 20 years.	

3. **Type of Organization:**

Real Estate Developer	
Architectural/Engineering Consulting Office	
Commercial Broker	
Others Please specify….	

4. **Volume of office building projects that you were involved in compared to other types of projects:**

5. 0 - 25 %		25-50 %	
50 -75%		75-100%.	

PART II

You may kindly rate the importance of each factor, using the following evaluation terms:

4 = Very Important
3 = Important
2 = Somewhat Important
1 = Not Important

No	**Site Selection Factors**	**Evaluation Terms**			
Zoning Regulations		**VI**	**I**	**SI**	**NI**
1.	Main Street Width and its affects on the location decision.				
2.	Minimum and maximum building heights and setbacks resulting from codes and local regulations.				
3.	Availability of adequate number of parking spaces for employees and customers.				
4.	Existing land uses (residence, commercial, industrial).				
5.	Evaluation of how the site corresponds to future expansion in the community.				
6.	Site suitability for the proposed facility and its impacts on the company objectives.				
Geographical Aspects		**VI**	**I**	**SI**	**NI**
7.	Proximity to facilities which shared between several offices (mosque, hospital, police, food facilities, fire department).				
8.	Site Location within the city fabrics (city centre, edges)				
9.	Protective measures that may required for safety and security.				
10.	The characteristics of community and/ or location in terms of quality of life.				
11.	Assessment of urban landscaping.				
12.	Aesthetic value of the site itself as well as visible off site features (views to historical buildings, land marks, famous mountain).				
Spatial Configuration		**VI**	**I**	**SI**	**NI**
13.	Site area in relation with functional spaces to be required.				
14.	Site allowance for future expansion.				
15.	Site geometry (rectangle, square, triangle) and its affects on the development potential as well as design flexibility.				
16.	Adequate analysis of the site topography.				
Utilities		**VI**	**I**	**SI**	**NI**
17.	Availability of adequate, power supply system.				

18.	Connection into an existing, reliable water supply system with adequate capacity.				
19.	Connection into an existing, reliable sewage system.				
20.	Availability of site drainage system.				
21.	Availability of communication services (Tel. lines and IT services).				
22.	Using alternative energy source.				
Environmental Aspects		**VI**	**I**	**SI**	**NI**
23.	Site considerations for the quality of air (smoke, dust, odors).				
24.	Site considerations for orientation to the sun and wind.				
25.	Soil characteristics that affect the development and plant growth (acidity, erosion potential, depth of bedrocks).				
26.	The influence of surface water (hydrology).				
27.	Site proximity to the natural hazards area (earthquakes, avalanches, volcanic activity, flooding potential and landslides).				
28.	Site investigations for potential hazardous materials.				
29.	General climatic conditions related to the site (temperature, humidity, wind, rainfall, solar radiation)				
30.	Site investigations for the potential sources of noise (operation close to airports, rail road's and high traffic jam).				
Transportation Aspects		**VI**	**I**	**SI**	**NI**
31.	Proximity to a good public transport, freeways and connecting streets.				
32.	Proximity of transportation routes which can support heavy equipments for construction.				
33.	Accessibility of ready access to/ from the site.				
Financial Aspects		**VI**	**I**	**SI**	**NI**
34.	Availability of a site on free of legal load and at reasonable cost.				
35.	Market changes for supply and demand conditions.				
36.	Reasonable and accurate estimate of future taxes and incentive.				
37.	Evaluation of the potential sites in terms of the development cost (utilities installations, site preparation…..etc)				
38.	Labor characteristics (Cost and availability of skilled labor).				
39.	Others: ----------				
40.	Others: ----------				

Thank you for your Cooperation.

Please return the filled survey by fax to:

Engr. Mahmoud Hamwda

Fax:

Mobile:

دراسة العوامل المؤثرة على اختيار موقع المباني المكتبية في المملكة العربية السعوديةِ

تهدفَ هذه الدراسةِ إلى تعريف و تقييم العواملَ المؤثرة على قرارِ اختيار موقع المباني المكتبية بالمملكة العربية السعودية .
و يهدفَ الاستبيان المرفق إلى معرفة رأيكَم حول العوامل الضرورية وتحديد درجة كل عامل مؤثر على قرار الاختيار.
مساهمتكَ في هذا الاستبيان سَيُؤدّي إلى فَهْم أفضل للعواملِ التي تُؤثّرُ على قرارِ اختيار موقع المباني المكتبية. ونؤكد لكم أن المعلومات لن تستخدم إلا لغرض البحث فقط.
.يرجى منكم المساهمة في تقدير أهميةِ كُلّ عامل يؤثر على القرار و إضافة أي عوامل ترونها مناسبة
هذا الاستبيان يشتمل على جزئيين الجزء الأول معلومات عامة أما الجزء الثاني المعلومات المطلوبة لمقارنة العوامل.

معلومات عامة

الاسم (اختياري)	
الموقع الوظيفي (اختياري)	
التلفون (اختياري)	
الفاكس (اختياري)	
الايميل (اختياري)	
عنوان العمل (اختياري)	

مدة الخبرة في العمل

اقل من 5 سنوات		من 5 إلى 10 سنوات	
من 10 إلى 20 سنة		أكثر من 20 سنة	

جهة العمل

احدى شركات التطوير العقاري	
مكتب استشاري معماري	
مكتب عقاري	

حجم العمل بالمباني المكتبية مقارنة بانواع المباني الاخرى:

%25 -0		%50 -25	
%75-50		%100-75	

	العوامل المؤثرة في عملية اختيار الموقع	**مقياس التقييم**			
	اللوائح والتنظيمات المحلية	مهم جداً	مهم	نوعاً ما	غير مهم
.1	وتأثيره على عملية الاختيار. المقترح للمشروع عرض الشارع الرئيسي المقابل للموقع				
.2	الارتفاع او الارتداد المسموح به للمباني بالمنطقة المحيطة بالموقع طبقا للوائح والانظمة المحلية.				
.3	توفر المساحة الكافية المخصصة لمواقف سيارات الموظفين والعملاء على الشارع الرئيسي				
.4	نوع الاستخدام الحالي المسموح به (سكني، تجاري، صناعي) و تحديد العوائق المحتملة وتحليلها				
.5	تقييم امكانية توافق الموقع مع خطط التوسع المستقبلي للمشروع واستخدامات الاراضي بالمنطقة.				
.6	ملائمة الموقع المحدد لاستيعاب انشطة المشروع المقترح				

	العوامل الجغرافية	مهم جداً	مهم	نوعاً ما	غير مهم
.7	قرب الموقع من المرافق والخدمات العامة (الشرطة، الدفاع المدني، البنوك ،المستشفيات)				
.8	الموقع بالنسبة لنسيج المدينة هل هو ضمن نطاق (المركز،اطراف المدينة)				
.9	الاحتياطات اللازمة لتامين الامن والسلامة بالمنطقة.				
.10	الحالة الاجتماعية بالمنطقة وجودة الحياة بصورة عامة للمنطقة من حيث مستوى الخدمات العامة)				
.11	الغطاء النباتي والتشجير بالموقع والمناطق والشوارع المحيطة.				
.12	البعد البصري للموقع ،وامكانية مشاهدة مواقع اخرى يطل عليها الموقع أو مباني مجاورة له (مباني تاريخية، معالم رئيسية، مباني اخرى هامة).				
	العوامل التصميمية	مهم جداً	مهم	نوعاً ما	غير مهم
.13	مساحة الموقع وملائمتها للمتطلبات والفراغات الوظيفية للمشروع .				
.14	توفر المساحة الكافية لامكانية التوسع المستقبلي للمشروع .				
.15	الشكل الهندسي العام للموقع (مربع، مستطيل، شبه منحرف، مثلث) وتأثيره على عملية التطوير.				
.16	دراسة تضاريس الموقع (مستوي، فوق هضبة، فوق جبل).				
	الخدمات	مهم جداً	مهم	نوعاً ما	غير مهم
.17	توفر مصدر رئيسي كافي لامداد الموقع بالتيار الكهربائي.				
.18	توفر شبكة مياه عمومية لامداد الموقع بالمياه.				
.19	توفر شبكة صرف صحي عمومية بالموقع.				
.20	سهولة تصريف مياه الامطار بالموقع.				
.21	توفر خدمات الهاتف وشبكات الاتصال بالموقع.				
.22	توفر مصادر للطاقة البديلة المستخدمة بالموقع.				
	العوامل البيئية	مهم جداً	مهم	نوعاً ما	غير مهم
.23	مستوى جودة الهواء بالمنطقة والتأكد من خلوه من الملوثات (الدخان، الاتربة).				
.24	توجيه الموقع من حيث الاشعاع الشمسي واتجاه الرياح .				
.25	دراسة حالة التربة بالموقع (نسبة الحموضة، امكانية حدوث الصدأ) وتأثير ذلك على عملية التطوير ونمو النباتات.				
.26	مستوى المياه السطحية بالموقع وأثر ذلك على عملية التطوير.				
.27	قرب الموقع من مناطق المخاطر الطبيعية (الزلازل، البراكين ، ، الفيضانات، الانزلاقات الأرضية)				
.28	امكانية احتواء الموقع على بعض المواد الملوثة الخطرة نتيجة للاستخدام الصناعي أو رمي بعض انواع المخلفات.				
.29	حالة المناخ العام والطقس للمنطقة (الحرارة، الرطوبة، الرياح، الأمطار، الأشعاع الشمسي)				
.30	امكانية تعرض الموقع لمصادر التلوث الضوضائي (القرب من المطارات، السكك الحديدية، تقاطع الشوارع المزدحمة)				
	المواصلات	مهم جداً	مهم	نوعاً ما	غير مهم
.31	قرب الموقع من خطوط ونقاط المواصلات العامة المؤدية من والى مركز المدينة.				
.32	قرب الموقع من طرق فرعية تسمح بمرور السيارات الكبيرة والمعدات المستخدمة في عمليات الانشاء.				
.33	توفر المداخل الرئيسية المجهزة من والى الموقع و سهولة الوصول للموقع				
	العوامل الاقتصادية	مهم جداً	مهم	نوعاً ما	غير مهم
.34	توفر الموقع بتكلفة معقولة اضافة الى خلوه من العوائق القانونية				
.35	تغيرات في العرض والطلب في سوق العقار المحلية.				
.36	الرسوم والضرائب المفروضة على العقار من قبل البلديات و السلطات المحلية				
.37	دراسة تكلفة تطوير الموقع (اعداد الموقع، الخدمات).				
.38	توفر العماله المحلية المدربة وتكلفتها.				

شكرا لتعاونكم

APPENDIX – B (Data & Results)

GENERAL INFORMATION

1. Sample distribution according to the respondents' categories

	Type of Organization	Number	Percent
1.	Real Estate Developer	19	32.8%
2.	Architectural/Engineering Consulting Office	21	36.2%
3.	Commercial Broker	18	31%
	Total	**58**	**100%**

2. Experience

Experience	Type of Organization			Total
	Commercial Broker	Architectural/Engineering Consulting Office	Real Estate Developers	
Less than 5 years	4	4	3	11
5-10 years	8	5	6	19
10-20 years	3	5	4	12
Over 20 years.	3	7	6	16
Total	**18**	**21**	**19**	**58**

3. Volume of office building projects that you were involved in compared to other types of projects

Experience	Type of Organization			Total
	Commercial Broker	Architectural/Engineering Consulting Office	Real Estate Developers	
0 - 25 %	3	8	9	20
25-50 %	7	7	4	18
50 -75%	5	3	4	12
75-100%.	3	3	2	8
Total	**18**	**21**	**19**	**58**

TECHNICAL INFORMATION

Frequencies of site selection factors according to the organization type (SPSS data sheet)

(A) Zoning Regulations

1. Main Street Width and its affects on the location decision

Scale	Type of Organization			Total
	Commercial Broker	Architectural/Engineering Consulting Office	Real Estate Developers	
Very Important	11	11	16	20
Important	7	7	3	18
Somewhat Important	0	3	0	12
Not Important	0	0	0	8
Total	**18**	**21**	**19**	**58**

2. Minimum and maximum building heights and setbacks.

Scale	Type of Organization			Total
	Commercial Broker	Architectural/Engineering Consulting Office	Real Estate Developers	
Very Important	9	5	15	29
Important	8	11	4	23
Somewhat Important	1	3	0	4
Not Important	0	2	0	2
Total	**18**	**21**	**19**	**58**

3. Availability of adequate number of parking spaces.

Scale	Type of Organization			Total
	Commercial Broker	Architectural/Engineering Consulting Office	Real Estate Developers	
Very Important	13	13	14	40
Important	4	5	3	12
Somewhat Important	1	3	2	6
Not Important	0	0	0	0
Total	**18**	**21**	**19**	**58**

4. Existing land uses (residence, commercial, industrial).

Scale	Type of Organization			Total
	Commercial Broker	Architectural/Engineering Consulting Office	Real Estate Developers	
Very Important	4	8	10	22
Important	10	9	8	27
Somewhat Important	4	3	1	8
Not Important	0	1	0	1
Total	**18**	**21**	**19**	**58**

5. Evaluation of how the site corresponds to future expansion in the community.

Scale	Type of Organization			Total
	Commercial Broker	Architectural/Engineering Consulting Office	Real Estate Developers	
Very Important	8	5	7	20
Important	7	9	8	24
Somewhat Important	3	6	4	13
Not Important	0	1	0	1
Total	**18**	**21**	**19**	**58**

6. Site suitability for the proposed facility and its impacts on the company objectives

Scale	Type of Organization			Total
	Commercial Broker	Architectural/Engineering Consulting Office	Real Estate Developers	
Very Important	9	11	12	32
Important	8	8	5	21
Somewhat Important	0	1	1	2
Not Important	1	1	1	3
Total	**18**	**21**	**19**	**58**

(B) Geographical Aspects

7. Proximity to facilities which shared between several offices.

Scale	Type of Organization			Total
	Commercial Broker	Architectural/Engineering Consulting Office	Real Estate Developers	
Very Important	10	5	7	22
Important	4	6	2	12
Somewhat Important	3	9	8	20
Not Important	1	1	2	4
Total	**18**	**21**	**19**	**58**

8. Site Location within the city fabrics (city centre, edges)

Scale	Type of Organization			Total
	Commercial Broker	Architectural/Engineering Consulting Office	Real Estate Developers	
Very Important	7	5	10	22
Important	7	13	6	12
Somewhat Important	4	3	3	20
Not Important	0	0	0	4
Total	**18**	**21**	**19**	**58**

9. Protective measures that may required for safety and security.

Scale	Type of Organization			Total
	Commercial Broker	Architectural/Engineering Consulting Office	Real Estate Developers	
Very Important	12	7	6	25
Important	6	8	11	25
Somewhat Important	0	6	2	8
Not Important	0	0	0	0
Total	**18**	**21**	**19**	**58**

10. The characteristics of community and/ or location in terms of quality of life.

Scale	Type of Organization			Total
	Commercial Broker	Architectural/Engineering Consulting Office	Real Estate Developers	
Very Important	8	6	8	22
Important	9	10	7	26
Somewhat Important	1	5	4	10
Not Important	0	0	0	0
Total	**18**	**21**	**19**	**58**

11. Assessment of urban landscaping.

Scale	Type of Organization			Total
	Commercial Broker	Architectural/Engineering Consulting Office	Real Estate Developers	
Very Important	4	3	4	11
Important	8	7	9	24
Somewhat Important	4	8	6	18
Not Important	2	3	0	5
Total	**18**	**21**	**19**	**58**

12. Aesthetic value of the site itself as well as visible off site features.

Scale	Type of Organization			Total
	Commercial Broker	Architectural/Engineering Consulting Office	Real Estate Developers	
Very Important	3	3	2	8
Important	10	11	9	30
Somewhat Important	3	3	4	10
Not Important	2	4	4	10
Total	**18**	**21**	**19**	**58**

(C) Spatial Configuration

13. Site area in relation with functional spaces to be required.

Scale	Type of Organization			Total
	Commercial Broker	Architectural/Engineering Consulting Office	Real Estate Developers	
Very Important	4	10	12	26
Important	12	9	6	27
Somewhat Important	2	2	1	5
Not Important	0	0	0	26
Total	**18**	**21**	**19**	**58**

14. Site allowance for future expansion.

Scale	Type of Organization			Total
	Commercial Broker	Architectural/Engineering Consulting Office	Real Estate Developers	
Very Important	5	7	4	16
Important	13	11	10	34
Somewhat Important	0	2	5	7
Not Important	0	1	0	1
Total	**18**	**21**	**19**	**58**

15. Site geometry (rectangle, square, triangle)

Scale	Type of Organization			Total
	Commercial Broker	Architectural/Engineering Consulting Office	Real Estate Developers	
Very Important	7	3	3	13
Important	9	8	12	29
Somewhat Important	2	5	4	11
Not Important	0	5	0	5
Total	**18**	**21**	**19**	**58**

16. Adequate analysis of the site topography.

Scale	Type of Organization			Total
	Commercial Broker	Architectural/Engineering Consulting Office	Real Estate Developers	
Very Important	10	5	4	4
Important	5	8	12	12
Somewhat Important	1	5	3	3
Not Important	2	3	0	0
Total	**18**	**21**	**19**	**58**

(D) Utilities

17. Availability of adequate, power supply system.

Scale	Type of Organization			Total
	Commercial Broker	Architectural/Engineering Consulting Office	Real Estate Developers	
Very Important	10	12	15	37
Important	5	7	3	15
Somewhat Important	2	1	1	4
Not Important	1	1	0	2
Total	**18**	**21**	**19**	**58**

18. Connection into an existing, reliable water supply system with adequate capacity.

Scale	Type of Organization			Total
	Commercial Broker	Architectural/Engineering Consulting Office	Real Estate Developers	
Very Important	12	11	14	37
Important	4	6	3	13
Somewhat Important	2	2	2	6
Not Important	0	2	0	2
Total	**18**	**21**	**19**	**58**

19. Connection into an existing, reliable sewage system.

Scale	Type of Organization			Total
	Commercial Broker	Architectural/Engineering Consulting Office	Real Estate Developers	
Very Important	12	10	12	34
Important	4	6	5	15
Somewhat Important	2	4	2	8
Not Important	0	1	0	1
Total	**18**	**21**	**19**	**58**

20. Availability of site drainage system.

Scale	Type of Organization			Total
	Commercial Broker	Architectural/Engineering Consulting Office	Real Estate Developers	
Very Important	10	8	12	30
Important	6	6	7	19
Somewhat Important	1	6	0	7
Not Important	1	1	0	2
Total	**18**	**21**	**19**	**58**

21. Availability of communication services.

Scale	Type of Organization			Total
	Commercial Broker	Architectural/Engineering Consulting Office	Real Estate Developers	
Very Important	10	15	11	36
Important	7	4	7	18
Somewhat Important	1	1	1	3
Not Important	0	1	0	1
Total	**18**	**21**	**19**	**58**

22. Using alternative energy source.

Scale	Type of Organization			Total
	Commercial Broker	Architectural/Engineering Consulting Office	Real Estate Developers	
Very Important	8	8	2	18
Important	7	5	14	26
Somewhat Important	2	6	3	11
Not Important	1	2	0	3
Total	**18**	**21**	**19**	**58**

(E) Environmental Aspects

23. Site considerations for the quality of air.

Scale	Type of Organization			Total
	Commercial Broker	Architectural/Engineering Consulting Office	Real Estate Developers	
Very Important	10	8	5	23
Important	7	9	12	28
Somewhat Important	1	3	2	6
Not Important	0	1	0	1
Total	**18**	**21**	**19**	**58**

24. Site considerations for orientation to the sun and wind.

Scale	Type of Organization			Total
	Commercial Broker	Architectural/Engineering Consulting Office	Real Estate Developers	
Very Important	8	5	4	17
Important	6	10	7	23
Somewhat Important	3	5	7	15
Not Important	1	1	1	3
Total	**18**	**21**	**19**	**58**

25. Soil characteristics.

Scale	Type of Organization			Total
	Commercial Broker	Architectural/Engineering Consulting Office	Real Estate Developers	
Very Important	7	4	2	13
Important	8	6	11	25
Somewhat Important	3	9	4	16
Not Important	0	2	2	4
Total	**18**	**21**	**19**	**58**

26. The influence of surface water (hydrology).

Scale	Type of Organization			Total
	Commercial Broker	Architectural/Engineering Consulting Office	Real Estate Developers	
Very Important	10	7	4	21
Important	5	6	12	23
Somewhat Important	3	7	3	13
Not Important	0	1	0	1
Total	**18**	**21**	**19**	**58**

27. Site proximity to the natural hazards area.

Scale	Type of Organization			Total
	Commercial Broker	Architectural/Engineering Consulting Office	Real Estate Developers	
Very Important	9	9	9	27
Important	5	4	3	12
Somewhat Important	3	5	7	15
Not Important	1	3	0	4
Total	**18**	**21**	**19**	**58**

28. Site investigations for potential hazardous materials.

Scale	Type of Organization			Total
	Commercial Broker	Architectural/Engineering Consulting Office	Real Estate Developers	
Very Important	10	10	11	31
Important	6	8	5	19
Somewhat Important	1	2	2	5
Not Important	1	1	1	3
Total	**18**	**21**	**19**	**58**

29. General climatic conditions.

Scale	Type of Organization			Total
	Commercial Broker	Architectural/Engineering Consulting Office	Real Estate Developers	
Very Important	5	2	2	9
Important	8	7	9	24
Somewhat Important	3	11	6	20
Not Important	2	1	2	5
Total	**18**	**21**	**19**	**58**

30. Site investigations for the potential sources of noise.

Scale	Type of Organization			Total
	Commercial Broker	Architectural/Engineering Consulting Office	Real Estate Developers	
Very Important	6	6	6	18
Important	8	9	7	24
Somewhat Important	4	5	6	15
Not Important	0	1	0	1
Total	**18**	**21**	**19**	**58**

(F)Transportation Aspects

31. Proximity to a good public transport

Scale	Type of Organization			Total
	Commercial Broker	Architectural/Engineering Consulting Office	Real Estate Developers	
Very Important	10	10	14	34
Important	6	8	2	16
Somewhat Important	2	3	2	7
Not Important	0	0	1	1
Total	**18**	**21**	**19**	**58**

32. Proximity of transportation routes which can support heavy equipments for construction.

Scale	Type of Organization			Total
	Commercial Broker	Architectural/Engineering Consulting Office	Real Estate Developers	
Very Important	9	6	5	20
Important	6	8	11	25
Somewhat Important	3	6	2	11
Not Important	0	1	1	2
Total	**18**	**21**	**19**	**58**

33. Accessibility of ready access to/ from the site.

Scale	Type of Organization			Total
	Commercial Broker	Architectural/Engineering Consulting Office	Real Estate Developers	
Very Important	10	9	12	31
Important	7	9	7	23
Somewhat Important	1	3	0	4
Not Important	0	0	0	0
Total	**18**	**21**	**19**	**58**

(G) Financial Aspects

34. Availability of a site on free of legal load and at reasonable cost.

Scale	Type of Organization			Total
	Commercial Broker	Architectural/Engineering Consulting Office	Real Estate Developers	
Very Important	11	9	12	32
Important	6	9	6	21
Somewhat Important	1	2	1	4
Not Important	0	1	0	1
Total	**18**	**21**	**19**	**58**

35. Market changes for supply and demand conditions.

Scale	Type of Organization			Total
	Commercial Broker	Architectural/Engineering Consulting Office	Real Estate Developers	
Very Important	8	6	8	22
Important	7	12	8	27
Somewhat Important	3	2	3	8
Not Important	0	1	0	1
Total	**18**	**21**	**19**	**58**

36. Reasonable and accurate estimate of future taxes and incentive.

Scale	Type of Organization			Total
	Commercial Broker	Architectural/Engineering Consulting Office	Real Estate Developers	
Very Important	2	3	4	9
Important	11	13	7	31
Somewhat Important	5	4	6	15
Not Important	0	1	2	3
Total	**18**	**21**	**19**	**58**

37. Evaluation of the potential sites in terms of the development cost.

Scale	Type of Organization			Total
	Commercial Broker	Architectural/Engineering Consulting Office	Real Estate Developers	
Very Important	14	9	10	33
Important	3	6	5	14
Somewhat Important	1	6	4	11
Not Important	0	0	0	0
Total	**18**	**21**	**19**	**58**

38. Labor characteristics (Cost and availability of skilled labor).

Scale	Type of Organization			Total
	Commercial Broker	Architectural/Engineering Consulting Office	Real Estate Developers	
Very Important	8	7	6	21
Important	8	5	10	23
Somewhat Important	2	5	2	9
Not Important	0	4	1	5
Total	**18**	**21**	**19**	**58**

حساب التكرارات للعوامل المؤثرة في عملية اختيار الموقع وفق جهة العمل

أولاً: اللوائح والتنظيمات المحلية:

1 - عرض الشارع الرئيسي المقابل للموقع المقترح للمشروع وتأثيره على عملية الإختيار:

	جهة العمل			المجموع
	شركات التطوير العقاري	المكاتب الاستشارية	المكاتب العقارية	
مهم جداً	16	11	11	38
مهم	3	7	7	17
نوعاً ما	0	3	0	3
المجموع	19	21	18	58

2 - الارتفاع أو الارتداد المسموح به للمباني بالمنطقة المحيطة بالموقع طبقاً للوائح والأنظمة المحلية:

	جهة العمل			المجموع
	شركات التطوير العقاري	المكاتب الاستشارية	المكاتب العقارية	
مهم جداً	15	5	9	29
مهم	4	11	8	23
نوعاً ما	0	3	1	4
غير مهم	0	2	0	2
المجموع	19	21	18	58

3 - توفر المساحة الكافية المخصصة لمواقف سيارات الموظفين والعملاء على الشارع الرئيسي:

	جهة العمل			المجموع
	شركات التطوير العقاري	المكاتب الاستشارية	المكاتب العقارية	
مهم جداً	14	13	13	40
مهم	3	5	4	12
نوعاً ما	2	3	1	6
المجموع	19	21	18	58

4 - نوع الاستخدام الحالي المسموح به (سكني، تجاري، صناعي) وتحديد العوائق المحتملة وتحليلها:

	جهة العمل			المجموع
	شركات التطوير العقاري	المكاتب الاستشارية	المكاتب العقارية	
مهم جداً	10	8	4	22
مهم	8	9	10	27
نوعاً ما	1	3	4	8
غير مهم	0	1	0	1
المجموع	19	21	18	58

5 - تقييم إمكانية توافق الموقع مع خطط التوسع المستقبلي للمشروع واستخدامات الأراضي بالمنطقة:

	جهة العمل			المجموع
	شركات التطوير العقاري	المكاتب الاستشارية	المكاتب العقارية	
مهم جداً	7	5	8	20
مهم	8	9	7	24
نوعاً ما	4	6	3	13
غير مهم	0	1	0	1
المجموع	19	21	18	58

6 - ملائمة الموقع المحدد لاستيعاب أنشطة المشروع المقترح:

	جهة العمل			المجموع
	شركات التطوير العقاري	المكاتب الاستشارية	المكاتب العقارية	
مهم جداً	12	11	9	32
مهم	5	8	8	21
نوعاً ما	1	1	0	2
غير مهم	1	1	1	3
المجموع	19	21	18	58

ثانياً: العوامل الجغرافية:

7- قرب الموقع من المرافق والخدمات العامة (الشرطة، الدفاع المدني، البنوك، المستشفيات):

	جهة العمل			المجموع
	شركات التطوير العقاري	المكاتب الاستشارية	المكاتب العقارية	
مهم جداً	7	5	10	22
مهم	2	6	4	12
نوعاً ما	8	9	3	20
غير مهم	2	1	1	4
المجموع	19	21	18	58

8- الموقع بالنسبة لنسيج المدينة هل هو ضمن نطاق المدينة (المركز، أطراف المدينة):

	جهة العمل			المجموع
	شركات التطوير العقاري	المكاتب الاستشارية	المكاتب العقارية	
مهم جداً	10	5	7	22
مهم	6	13	7	26
نوعاً ما	3	3	4	10
المجموع	19	21	18	58

9- الاحتياطات اللازمة لتأمين الأمن والسلامة بالمنطقة:

	جهة العمل			المجموع
	شركات التطوير العقاري	المكاتب الاستشارية	المكاتب العقارية	
مهم جداً	6	7	12	25
مهم	11	8	6	25
نوعاً ما	2	6	0	8
المجموع	19	21	18	58

10- الحالة الاجتماعية بالمنطقة وجودة الحياة بصورة عامة من حيث مستوى الخدمات:

	جهة العمل			المجموع
	شركات التطوير العقاري	المكاتب الاستشارية	المكاتب العقارية	
مهم جداً	8	6	8	22
مهم	7	10	9	26
نوعاً ما	4	5	1	10
المجموع	19	21	18	58

11- الغطاء النباتي والتشجير بالمواقع والمناطق والشوارع المحيطة:

	جهة العمل			المجموع
	شركات التطوير العقاري	المكاتب الاستشارية	المكاتب العقارية	
مهم جداً	4	3	4	11
مهم	9	7	8	24
نوعاً ما	6	8	4	18
غير مهم	0	3	2	5
المجموع	19	21	18	58

12- البعد البصري للموقع وإمكانية مشاهدة مواقع أخرى يطل عليها الموقع أو مباني مجاورة له (مباني تاريخية، معالم رئيسية، مباني أخرى هامة):

	جهة العمل			المجموع
	شركات التطوير العقاري	المكاتب الاستشارية	المكاتب العقارية	
مهم جداً	2	3	3	8
مهم	9	11	10	30
نوعاً ما	4	3	3	10
غير مهم	4	4	2	10
المجموع	19	21	18	58

ثالثاً: العوامل التصميمية:

13- مساحة الموقع وملائمتها للمتطلبات والفراغات الوظيفية للمشروع:

	جهة العمل			المجموع
	شركات التطوير العقاري	المكاتب الاستشارية	المكاتب العقارية	
مهم جداً	12	10	4	26
مهم	6	9	12	27
نوعاً ما	1	2	2	5
المجموع	19	21	18	58

14- توفر المساحة الكافية لإمكانية التوسع المستقبلي:

	جهة العمل			المجموع
	شركات التطوير العقاري	المكاتب الاستشارية	المكاتب العقارية	
مهم جداً	4	7	5	16
مهم	10	11	13	34
نوعاً ما	5	2	0	7
غير مهم	0	1	0	1
المجموع	19	21	18	58

15- الشكل الهندسي العام للموقع (مربع، مستطيل ، شبه منحرف، مثلث) وتأثيره على عملية التطوير:

	جهة العمل			المجموع
	شركات التطوير العقاري	المكاتب الاستشارية	المكاتب العقارية	
مهم جداً	3	3	7	13
مهم	12	8	9	29
نوعاً ما	4	5	2	11
غير مهم	0	5	0	5
المجموع	19	21	18	58

16- دراسة تضاريس الموقع (مستوي، فوق هضبة، فوق جبل):

	جهة العمل			المجموع
	شركات التطوير العقاري	المكاتب الاستشارية	المكاتب العقارية	
مهم جداً	4	5	10	19
مهم	12	8	5	25
نوعاً ما	3	5	1	9
غير مهم	0	3	2	5
المجموع	19	21	18	58

رابعاً: الخدمات:

17- توفر مصدر رئيس كافي لإمداد الموقع بالتيار الكهربائي:

	جهة العمل			المجموع
	شركات التطوير العقاري	المكاتب الاستشارية	المكاتب العقارية	
مهم جداً	15	12	10	37
مهم	3	7	5	15
نوعاً ما	1	1	2	4
غير مهم	0	1	1	2
المجموع	19	21	18	58

18- توفر شبكة مياه عمومية لإمداد الموقع بالمياه:

	جهة العمل			المجموع
	شركات التطوير العقاري	المكاتب الاستشارية	المكاتب العقارية	
مهم جداً	14	11	12	37
مهم	3	6	4	13
نوعاً ما	2	2	2	6
غير مهم	0	2	0	2
المجموع	19	21	18	58

19- توفر شبكة صرف صحي عمومية بالموقع:

	جهة العمل			المجموع
	شركات التطوير العقاري	المكاتب الاستشارية	المكاتب العقارية	
مهم جداً	12	10	12	34
مهم	5	6	4	15
نوعاً ما	2	4	2	8
غير مهم	0	1	0	1
المجموع	19	21	18	58

20- سهولة تصريف مياه الأمطار بالموقع:

	جهة العمل			المجموع
	شركات التطوير العقاري	المكاتب الاستشارية	المكاتب العقارية	
مهم جداً	12	8	10	30
مهم	7	6	6	19
نوعاً ما	0	6	1	7
غير مهم	0	1	1	0
المجموع	19	21	18	58

21- توفر خدمات وشبكات الاتصال بالموقع :

	جهة العمل			المجموع
	شركات التطوير العقاري	المكاتب الاستشارية	المكاتب العقارية	
مهم جداً	11	15	10	36
مهم	7	4	7	18
نوعاً ما	1	1	1	3
غير مهم	0	1	0	1
المجموع	19	21	18	58

22- توفر مصادر للطاقة البديلة المستخدمة بالموقع :

	جهة العمل			المجموع
	شركات التطوير العقاري	المكاتب الاستشارية	المكاتب العقارية	
مهم جداً	2	8	8	18
مهم	14	5	7	26
نوعاً ما	3	6	2	11
غير مهم	0	2	1	3
المجموع	19	21	18	58

خامساً: العوامل البيئية:

23- مستوى جودة الهواء بالمنطقة والتأكد من خلوه من الملوثات (الدخان والأتربة):

	جهة العمل			المجموع
	شركات التطوير العقاري	المكاتب الاستشارية	المكاتب العقارية	
مهم جداً	5	8	10	23
مهم	12	9	7	28
نوعاً ما	2	3	1	6
غير مهم	0	1	0	1
المجموع	19	21	18	58

24- توجيه الموقع من حيث الإشعاع الشمسي واتجاه الرياح:

	جهة العمل			المجموع
	شركات التطوير العقاري	المكاتب الاستشارية	المكاتب العقارية	
مهم جداً	4	5	8	17
مهم	7	10	6	23
نوعاً ما	7	5	3	15
غير مهم	1	1	1	3
المجموع	19	21	18	58

25- دراسة حالة التربة بالموقع (نسبة الحموضة ، إمكانية حدوث الصدأ) وتأثير ذلك على عملية التطوير ونمو النباتات:

	جهة العمل			المجموع
	شركات التطوير العقاري	المكاتب الاستشارية	المكاتب العقارية	
مهم جداً	2	4	7	13
مهم	11	6	8	25
نوعاً ما	4	9	3	16
غير مهم	2	2	0	4
المجموع	19	21	18	58

26- مستوى المياه السطحية بالموقع وأثر ذلك على عملية التطوير:

	جهة العمل			المجموع
	شركات التطوير العقاري	المكاتب الاستشارية	المكاتب العقارية	
مهم جداً	14	7	10	21
مهم	12	6	5	23
نوعاً ما	3	7	3	13
غير مهم	0	1	0	1
المجموع	19	21	18	58

27- قرب الموقع من مناطق المخاطر الطبيعية (الزلازل، البراكين، الفيضانات، الإنزلاقات الأرضية):

	جهة العمل			المجموع
	شركات التطوير العقاري	المكاتب الاستشارية	المكاتب العقارية	
مهم جداً	9	9	9	27
مهم	3	4	5	12
نوعاً ما	7	5	3	15
غير مهم	0	3	1	4
المجموع	19	21	18	58

28- إمكانية إحتواء الموقع على بعض المواد الملوثة الخطرة نتيجة للاستخدام الصناعي ورمي المخلفات:

	جهة العمل			المجموع
	شركات التطوير العقاري	المكاتب الاستشارية	المكاتب العقارية	
مهم جداً	11	10	10	31
مهم	5	8	6	19
نوعاً ما	2	2	1	5
غير مهم	1	1	1	3
المجموع	19	21	18	58

29- حالة المناخ العام والطقس بالمنطقة (الحرارة، الرطوبة، الرياح، الأمطار، الإشعاع الشمسي):

	جهة العمل			المجموع
	شركات التطوير العقاري	المكاتب الاستشارية	المكاتب العقارية	
مهم جداً	2	2	5	9
مهم	9	7	8	24
نوعاً ما	6	11	3	20

غير مهم	2	1	2	5
المجموع	19	21	18	58

30- إمكانية تعرض الموقع لوسائل التلوث الضوضائي (القرب من المطارات، السكك الحديدية، الشوارع المزدحمة):

	جهة العمل			**المجموع**
	شركات التطوير العقاري	المكاتب الاستشارية	المكاتب العقارية	
مهم جداً	6	6	6	18
مهم	7	9	8	24
نوعاً ما	6	5	4	15
غير مهم	0	1	0	1
المجموع	19	21	18	58

سادساً: المواصلات:

31- قرب الموقع من خطوط ونقاط المواصلات العامة المؤدية من وإلى المدينة:

	جهة العمل			**المجموع**
	شركات التطوير العقاري	المكاتب الاستشارية	المكاتب العقارية	
مهم جداً	14	10	10	34
مهم	2	8	6	16
نوعاً ما	2	3	2	7
غير مهم	1	0	0	1
المجموع	19	21	18	58

32- قرب الموقع من طرق فرعية تسمح بمرور السيارات الكبيرة والمعدات المستخدمة في عمليات الإنشاء:

	جهة العمل			**المجموع**
	شركات التطوير العقاري	المكاتب الاستشارية	المكاتب العقارية	
مهم جداً	5	6	9	20
مهم	11	8	6	25
نوعاً ما	2	6	3	11
غير مهم	1	1	0	2
المجموع	19	21	18	58

33- توفر المداخل الرئيسية المجهزة من وإلى الموقع وسهولة الوصول للموقع:

	جهة العمل			**المجموع**
	شركات التطوير العقاري	المكاتب الاستشارية	المكاتب العقارية	
مهم جداً	12	9	10	31
مهم	7	9	7	23
نوعاً ما	0	3	1	4
المجموع	19	21	18	58

سابعاً: العوامل الاقتصادية:

34- توفر الموقع بتكلفة معقولة إضافة لخلوه من العوائق القانونية:

	جهة العمل			المجموع
	شركات التطوير العقاري	المكاتب الاستشارية	المكاتب العقارية	
مهم جداً	12	9	11	32
مهم	6	9	6	21
نوعاً ما	1	2	1	4
غير مهم	0	1	0	1
المجموع	19	21	18	58

35- تغيرات في العرض والطلب في سوق العقار المحلية:

	جهة العمل			المجموع
	شركات التطوير العقاري	المكاتب الاستشارية	المكاتب العقارية	
مهم جداً	8	6	8	22
مهم	8	12	7	27
نوعاً ما	3	2	3	8
غير مهم	0	1	0	1
المجموع	19	21	18	58

36- الرسوم والضرائب المفروضة على العقار من قبل البلديات والسلطات المحلية:

	جهة العمل			المجموع
	شركات التطوير العقاري	المكاتب الاستشارية	المكاتب العقارية	
مهم جداً	4	3	2	9
مهم	7	13	11	31
نوعاً ما	6	4	5	15
غير مهم	2	1	0	3
المجموع	19	21	18	58

37- دراسة تكلفة تطوير الموقع:

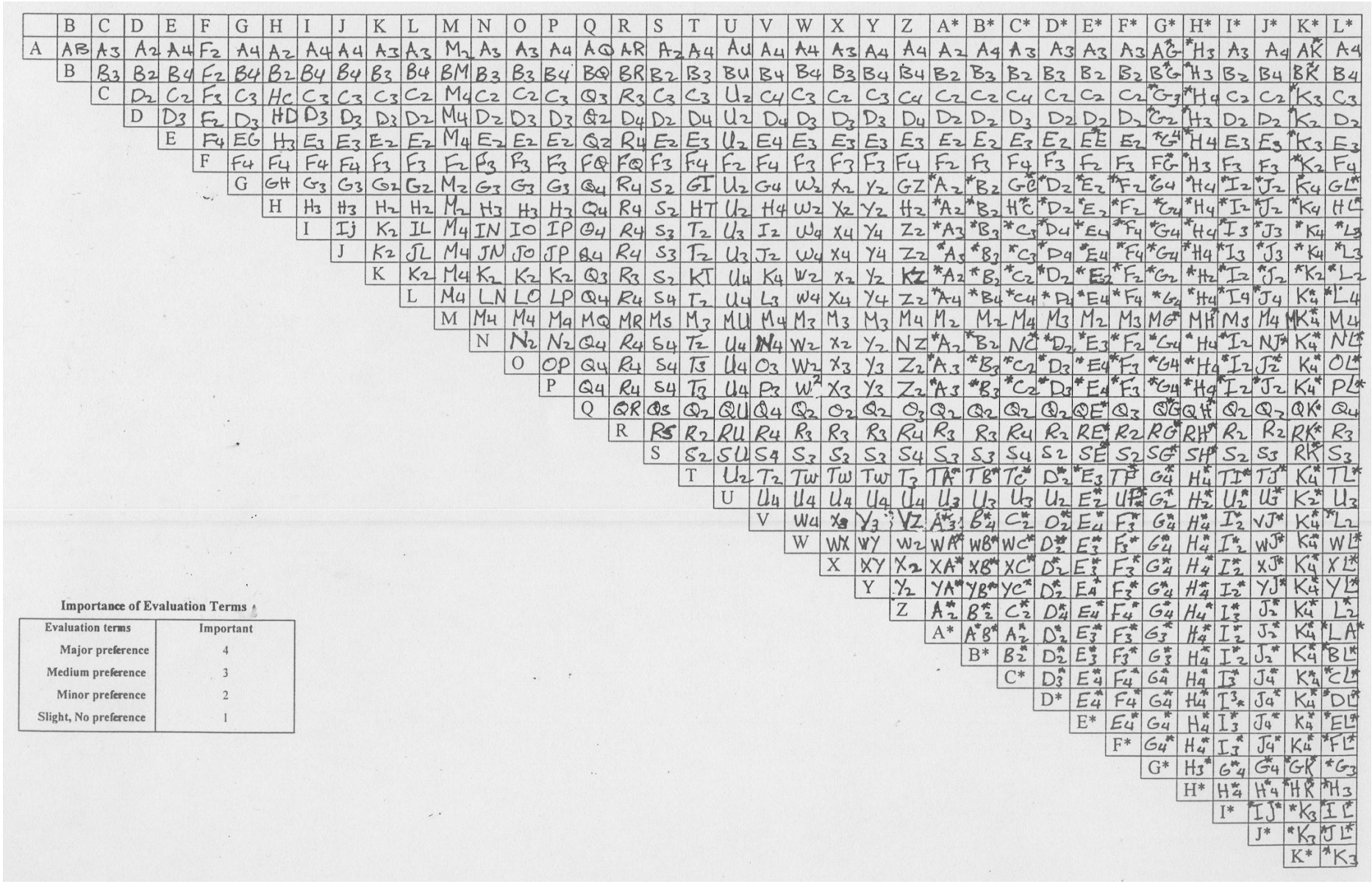
	جهة العمل			المجموع
	شركات التطوير العقاري	المكاتب الاستشارية	المكاتب العقارية	
مهم جداً	10	9	14	33
مهم	5	6	3	14
نوعاً ما	4	6	1	11
المجموع	19	21	18	58

38- توفر العمالة المحلية المدربة وتكلفتها:

	جهة العمل			المجموع
	شركات التطوير العقاري	المكاتب الاستشارية	المكاتب العقارية	
مهم جداً	6	7	8	21
مهم	10	5	8	23
نوعاً ما	2	5	2	9
غير مهم	1	4	0	5
المجموع	19	21	18	58

APPENDIX – C (Criteria Scoring Matrix)

CRITERIA SCORING MATRIX



Importance of Evaluation Terms

Evaluation terms	Important
Major preference	4
Medium preference	3
Minor preference	2
Slight, No preference	1

APPENDIX – D (MatLab Program for Consistency)

MatLab Progran for Consistency of Data Analysis

```
load O.mat              % Where O is a 38x38 Matrix of Pair-wise Comparisons

for n = 1:1:30
   A = O^(n+1);         % A matrix to the power of (n+1)
   B = sum (A,2);       % Addition of row elements
   C = sum (B);         % Eigenvalue of A
   D = B/C;             % Eigenvector of A
   E = [D]              % Displays the Eigenvector for A
   F = O^(n+2);         % A matrix to the power of (n+2)
   G = sum (F,2);       % Addition of row elements
   H = sum (G);         % Eigenvalue of F
   I = G/H;             % Eigenvector for F
   J = [I]              % Displays the Eigenvector for F
   K = I - D;           % Comparison of A & F Eigenvectors
   L = [K]              % Displays the comparison of Eigenvectors
   M = sum(abs(K));     % Summation of all the elements
      if (M<0.05)       % Sum shall be less than 0.05
      N = [D I K]       % Displays the final iteration
      n                 % No of iterations
         break

end
```

Results of the Consistency Analysis:

E =	J =	L =	N =		
0.0483	0.0480	-0.0003	0.0483	0.0480	-0.0003
0.0457	0.0456	-0.0001	0.0457	0.0456	-0.0001
0.0308	0.0301	-0.0007	0.0308	0.0301	-0.0007
0.0339	0.0333	-0.0005	0.0339	0.0333	-0.0005
0.0275	0.0270	-0.0005	0.0275	0.0270	-0.0005
0.0518	0.0521	0.0003	0.0518	0.0521	0.0003
0.0146	0.0148	0.0002	0.0146	0.0148	0.0002
0.0176	0.0180	0.0003	0.0176	0.0180	0.0003
0.0084	0.0087	0.0003	0.0084	0.0087	0.0003
0.0078	0.0081	0.0003	0.0078	0.0081	0.0003
0.0131	0.0136	0.0004	0.0131	0.0136	0.0004
0.0078	0.0081	0.0003	0.0078	0.0081	0.0003
0.0496	0.0501	0.0005	0.0496	0.0501	0.0005
0.0111	0.0114	0.0002	0.0111	0.0114	0.0002
0.0090	0.0093	0.0003	0.0090	0.0093	0.0003
0.0087	0.0090	0.0003	0.0087	0.0090	0.0003
0.0410	0.0415	0.0005	0.0410	0.0415	0.0005
0.0461	0.0463	0.0002	0.0461	0.0463	0.0002
0.0358	0.0358	-0.0000	0.0358	0.0358	-0.0000
0.0153	0.0153	0.0000	0.0153	0.0153	0.0000
0.0379	0.0376	-0.0002	0.0379	0.0376	-0.0002
0.0089	0.0092	0.0003	0.0089	0.0092	0.0003
0.0164	0.0164	0.0000	0.0164	0.0164	0.0000
0.0168	0.0169	0.0001	0.0168	0.0169	0.0001
0.0166	0.0167	0.0001	0.0166	0.0167	0.0001
0.0097	0.0099	0.0002	0.0097	0.0099	0.0002
0.0178	0.0180	0.0001	0.0178	0.0180	0.0001
0.0171	0.0172	0.0000	0.0171	0.0172	0.0000
0.0134	0.0135	0.0002	0.0134	0.0135	0.0002
0.0212	0.0208	-0.0004	0.0212	0.0208	-0.0004
0.0340	0.0331	-0.0010	0.0340	0.0331	-0.0010
0.0270	0.0259	-0.0011	0.0270	0.0259	-0.0011
0.0514	0.0513	-0.0002	0.0514	0.0513	-0.0002
0.0653	0.0662	0.0009	0.0653	0.0662	0.0009
0.0258	0.0252	-0.0006	0.0258	0.0252	-0.0006
0.0255	0.0249	-0.0006	0.0255	0.0249	-0.0006
0.0548	0.0546	-0.0002	0.0548	0.0546	-0.0002
0.0164	0.0166	0.0001	0.0164	0.0166	0.0001

n = 1

VITAE

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